



Diabetes, Hypertension, and More:

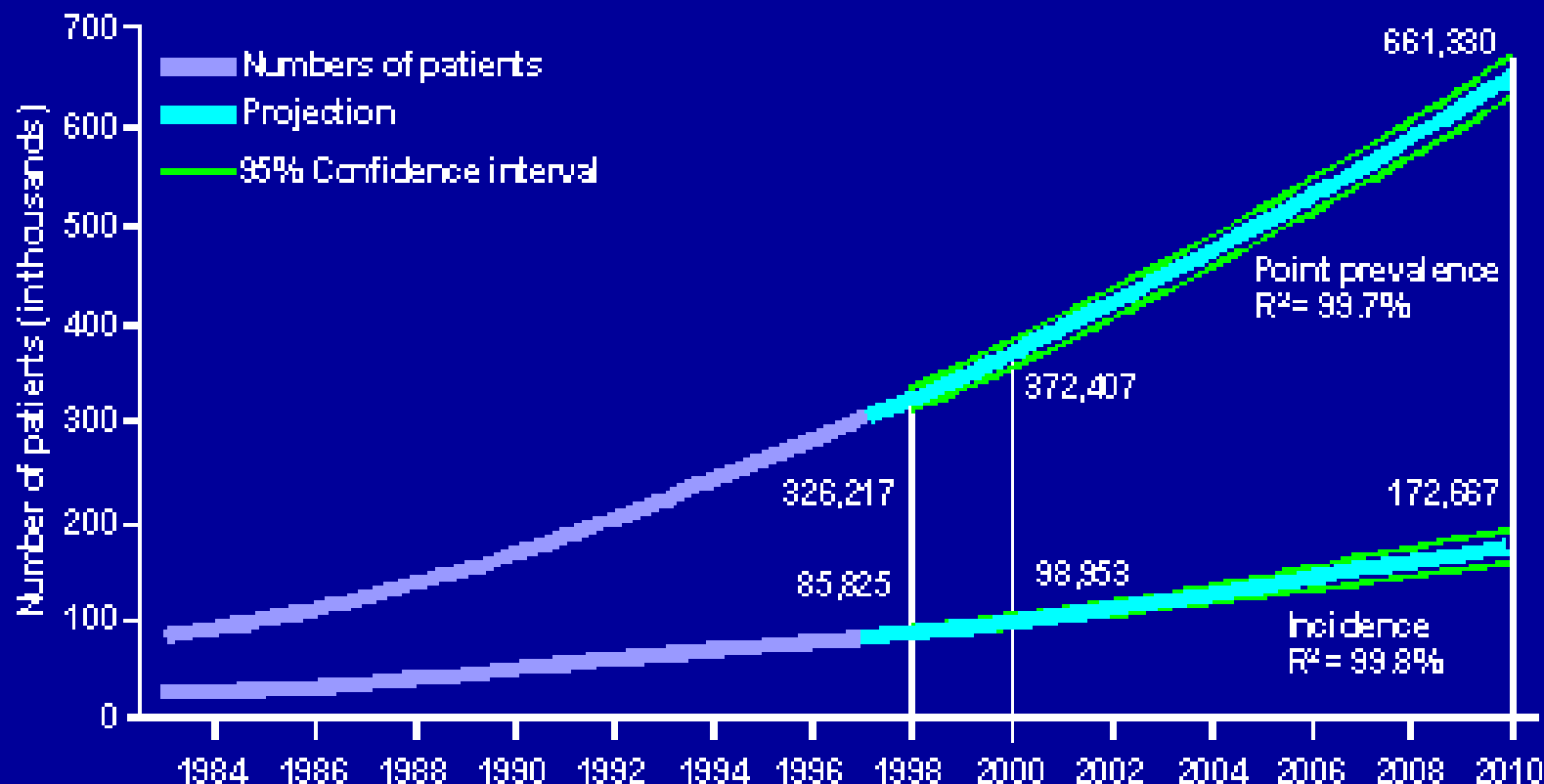
Managing the Patient with Chronic Kidney Disease (CKD)

Presented by the



National Kidney Foundation™
of SOUTH CAROLINA

Trends in Incidence and Prevalence of ESRD

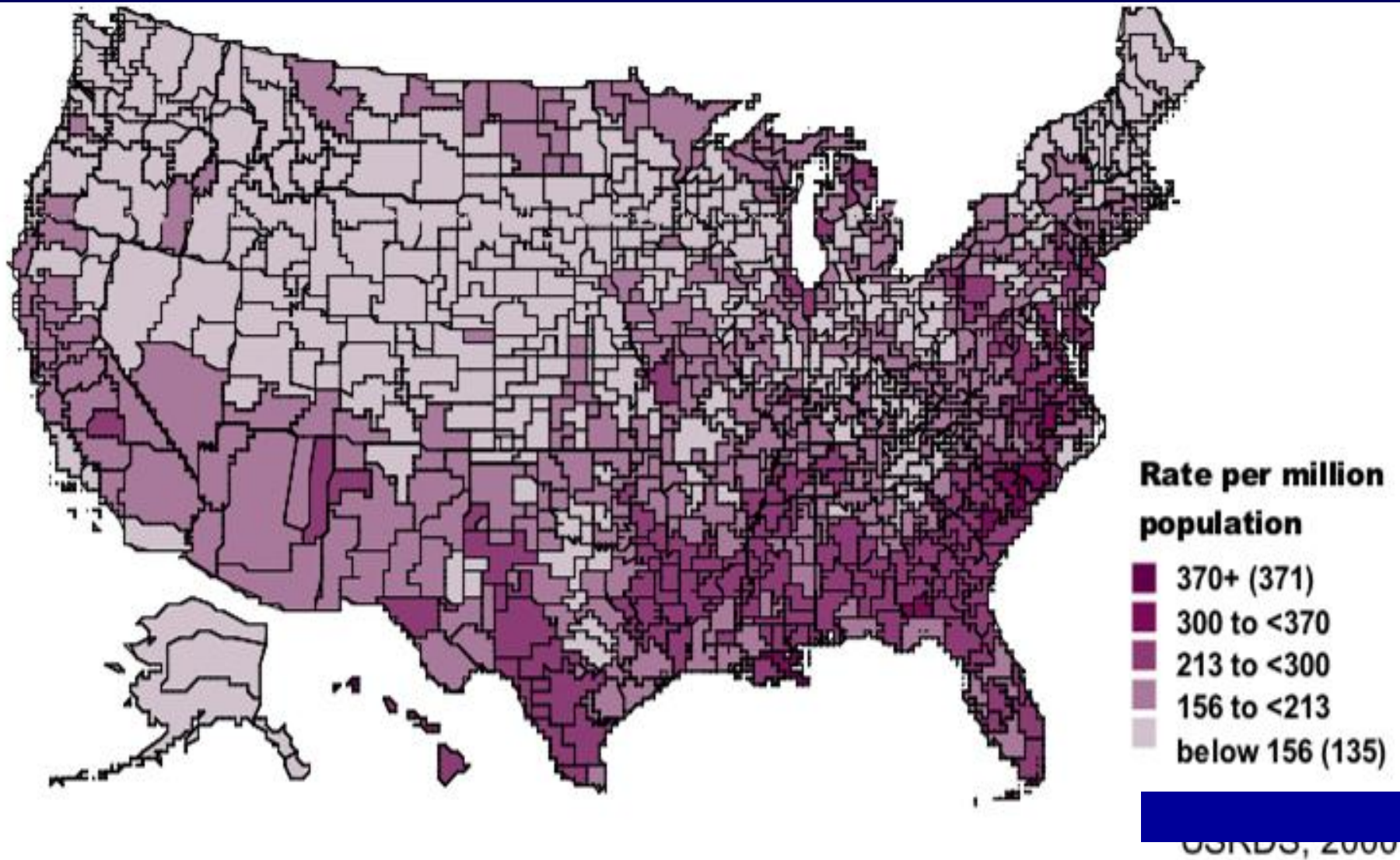


ESRD, end-stage renal disease.

US Renal Data System.
USRDS 2000 Annual Data Report.

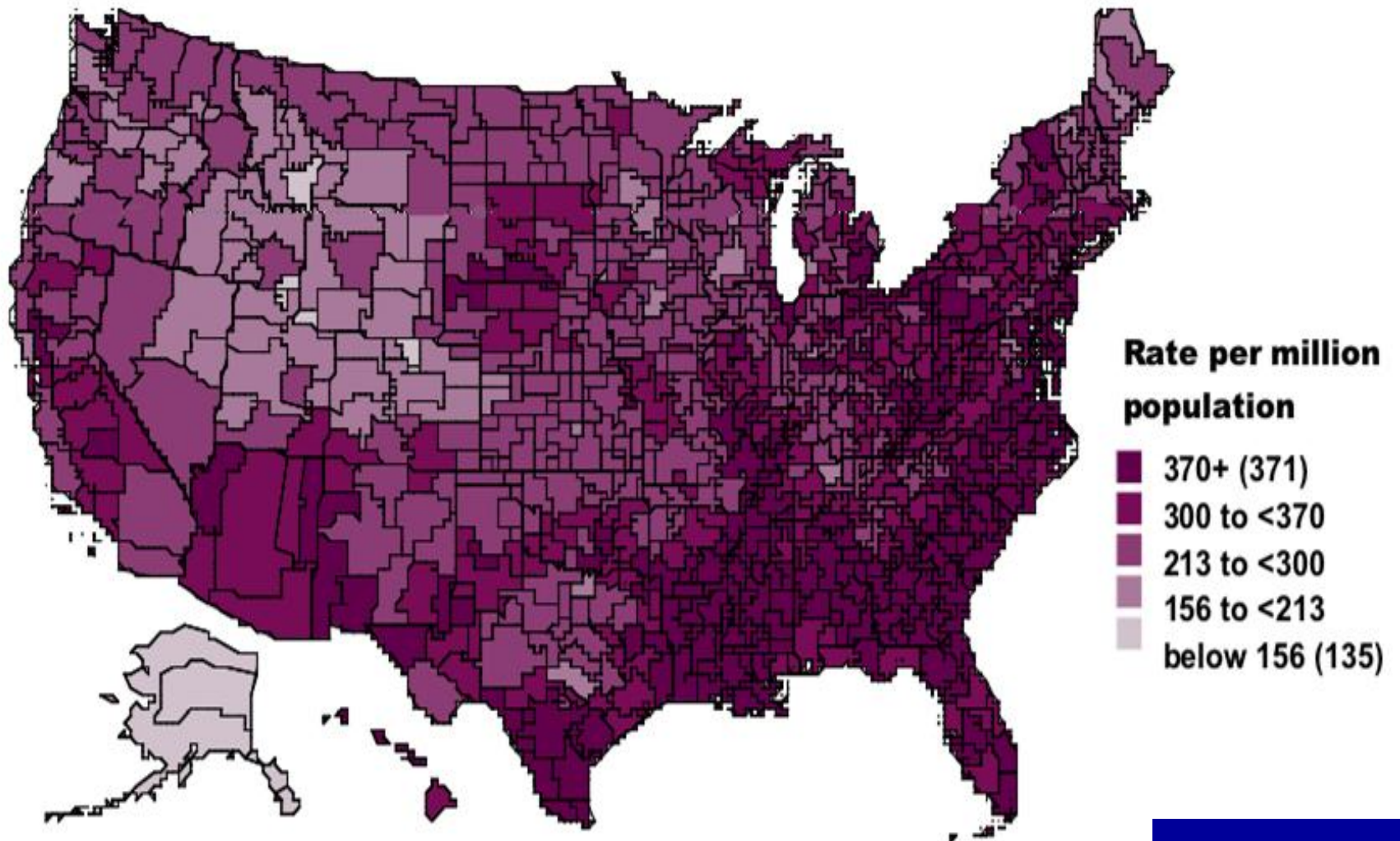
Incidence of Kidney Failure

(per million population, 1990, by HSA, unadjusted)



Incidence of Kidney Failure

(per million population, 2000, by HSA, unadjusted)



The Human Burden

- More than 500,000 Americans require dialysis or a kidney transplant to stay alive (1,542 patients per million population)

SOUTH CAROLINA:

- About 6700 patients are on dialysis in SC.
- The incidence rate is over 400 patients per million population
- In the last six years, the number of patients currently on dialysis and new cases has increased by over 30%
- SC is, per capita, third in the nation with the number of patients on dialysis

The Financial Burden

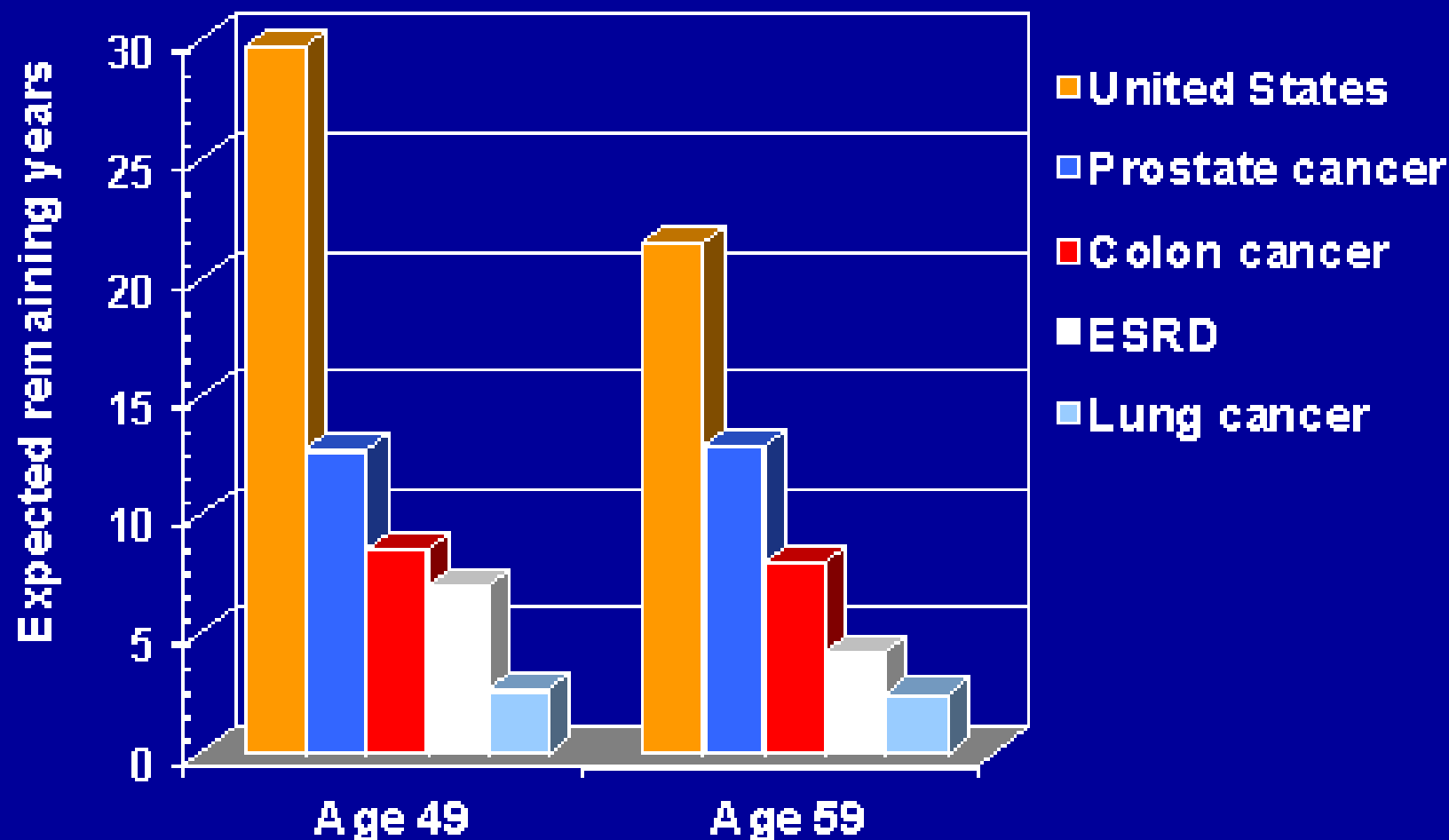
- Nearly 23 billion Medicare dollars were spent to treat patients with kidney failure in 2006 (and 13.3 billion non-Medicare \$)
- Medicare spending for kidney failure has been increasing at 5-10% per year, based primarily on growing number of patients
- Kidney failure patients constitute 1.2% of the Medicare population but require approximately 6.4 of the expenditures

The Financial Burden

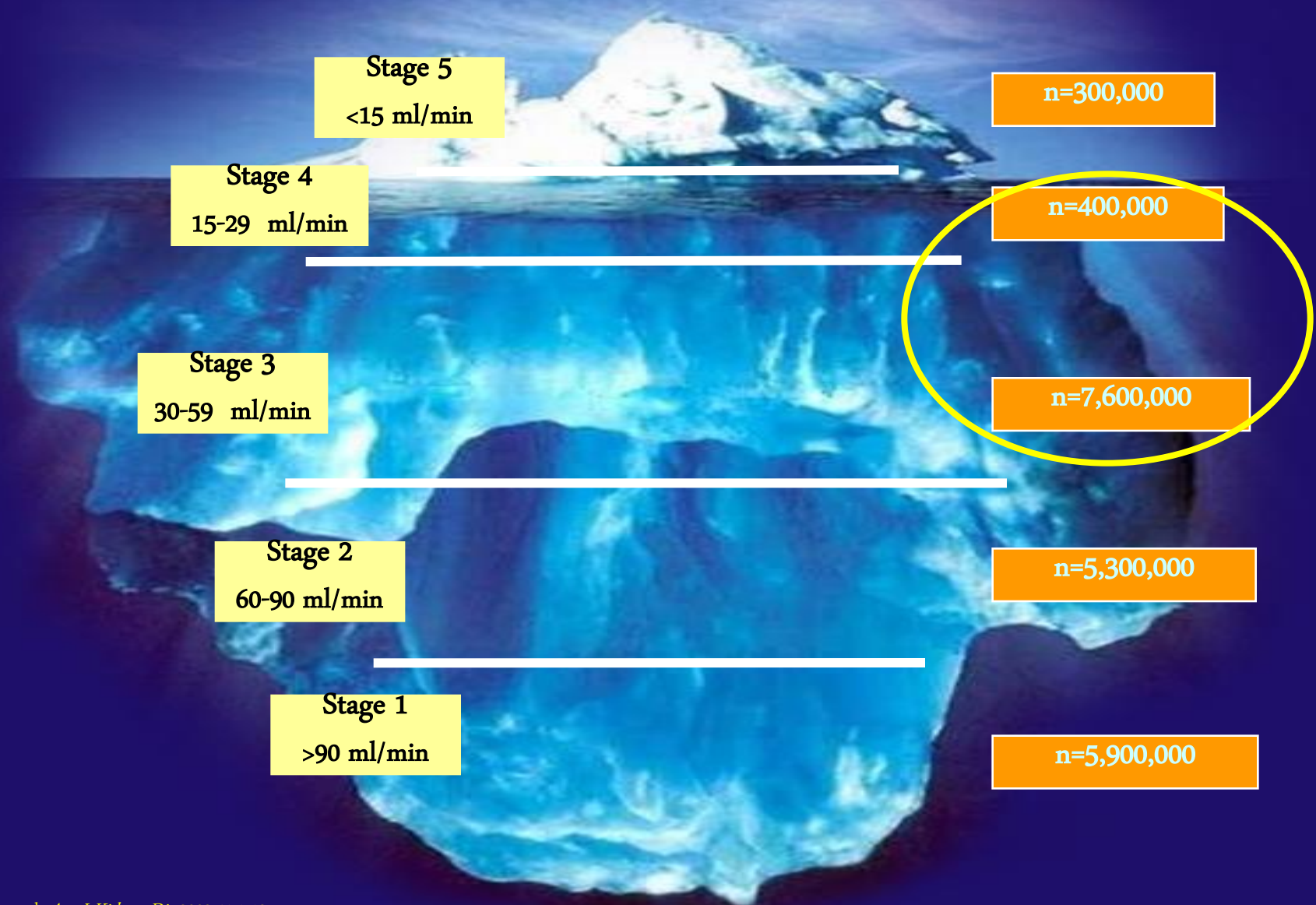
- Hemodialysis costs - \$ 71,889/ year (Medicare)
- Peritoneal dialysis - \$ 53,327 / year
- Renal transplant - \$ 24,952 / year
- Medicare costs , per patient per month

ESRD	\$4900
CKD	\$600

Life Expectancy for Selected Diseases



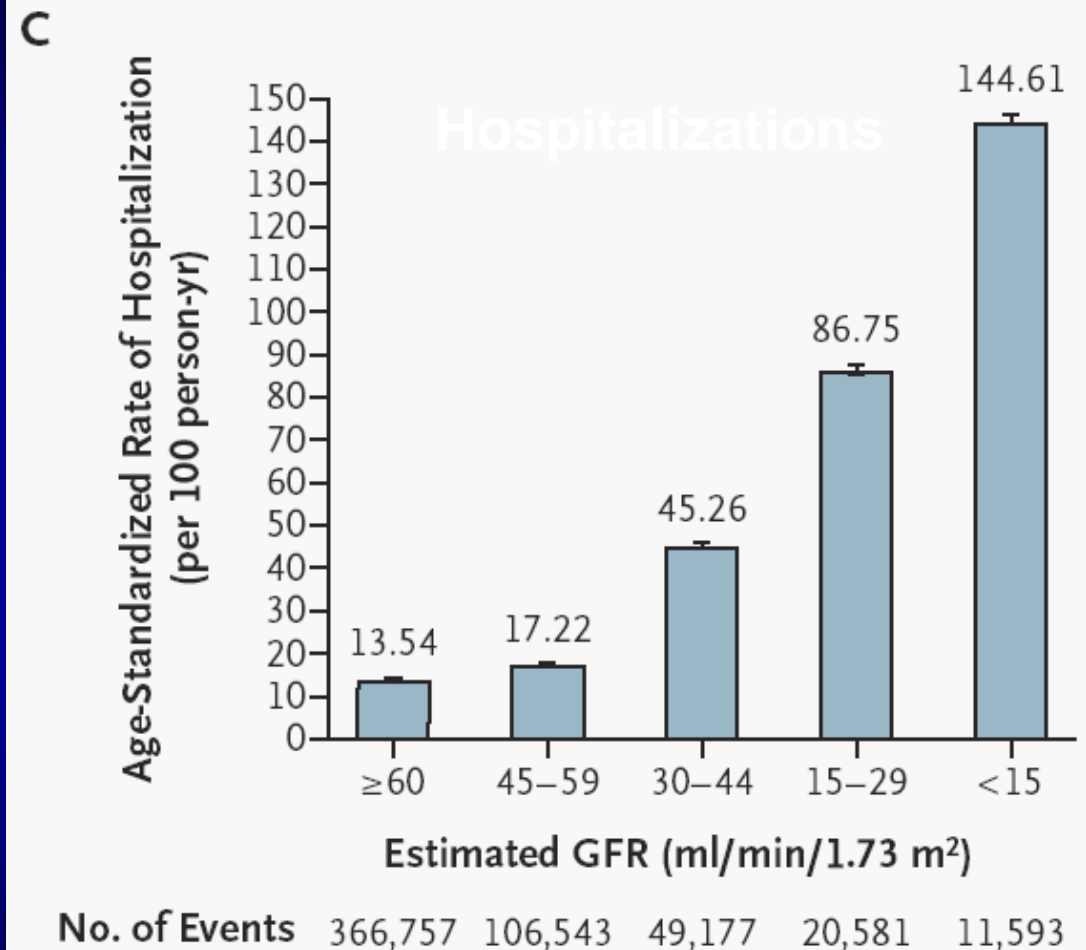
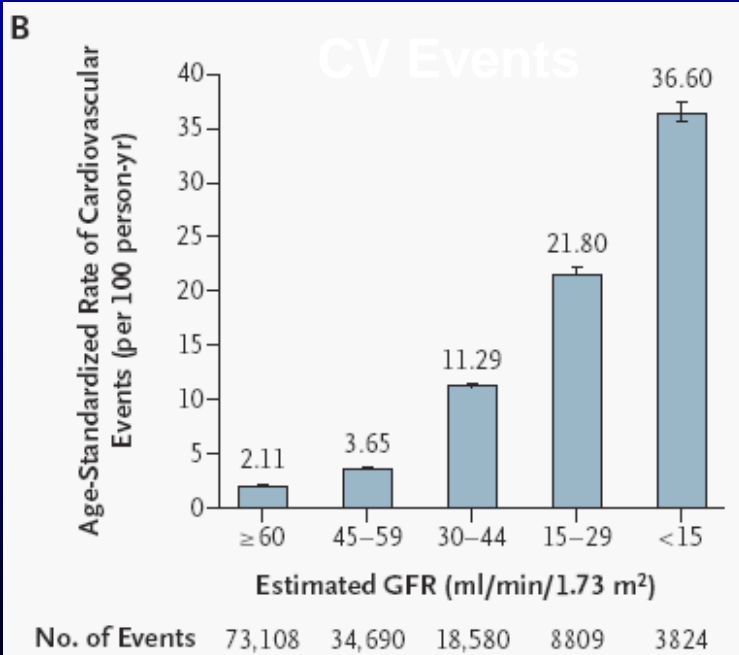
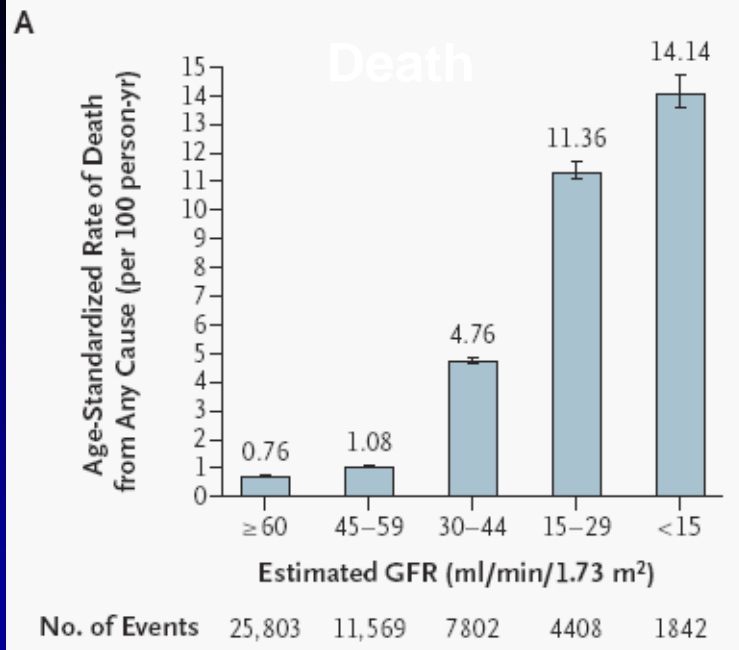
CKD population of 20M in U.S.



The Problem of Chronic Kidney Disease (CKD)

- 1 in 8 South Carolinians or 460, 000 residents have chronic kidney disease
- 75% of kidney patients in SC are African American
- Hospitalization rates are three times higher in CKD patients
- More than \$121 million was charged in 2004 for hospital visits in SC for kidney disease patients (SC DHEC)
- Nationally, patients with CKD account for 19.4% of Medicare costs in the year the disease is identified.
(6.6% of the population)

Economic Impact of ↓ GFR Seen in Early Stages of CKD



Go, et al. *N Engl J Med.* 2004;351:1296-1305

Chronic Kidney Disease – The Facts

- **Common & incidence is on the rise!!!**
- **Serious**
- **Costly**
- **Under-diagnosed & under- treated**
- **Preventable**
- **Manageable**

National Kidney Foundation

DOQITM

Kidney Disease Outcomes Quality Initiative

Definition of CKD

- Kidney damage for ≥ 3 months
 - Defined by structural or functional abnormalities of the kidney, with or without decreased glomerular filtration rate (GFR)
- GFR < 60 mL/min/1.73 m² for ≥ 3 months
- New staging for CKD is primarily based on kidney function

**National Kidney Foundation – Kidney Disease Outcomes
Quality Initiative (NKF-K/DOQI)
Stages of Chronic Kidney Disease**

Stage	Description	GFR (ml/min/1.73 m²)
1	Kidney Damage with Normal or ↑ GFR	>90
2	Mild ↓ GFR	60-89
3	Moderate ↓ GFR	30-59
4	Severe ↓ GFR	15-29
5	Kidney Failure	<15 or Dialysis

Why Estimate GFR From SCr, Instead of Using SCr for Kidney Function?

Age	Gender	Race	SCr (mg/dL)	eGFR (mL/min/1.73 m ²)	CKD Stage
20	M	B	1.3	91	1*
20	M	W	1.3	75	2*
55	M	W	1.3	61	2*
20	F	W	1.3	56	3
55	F	B	1.3	55	3
50	F	W	1.3	46	3

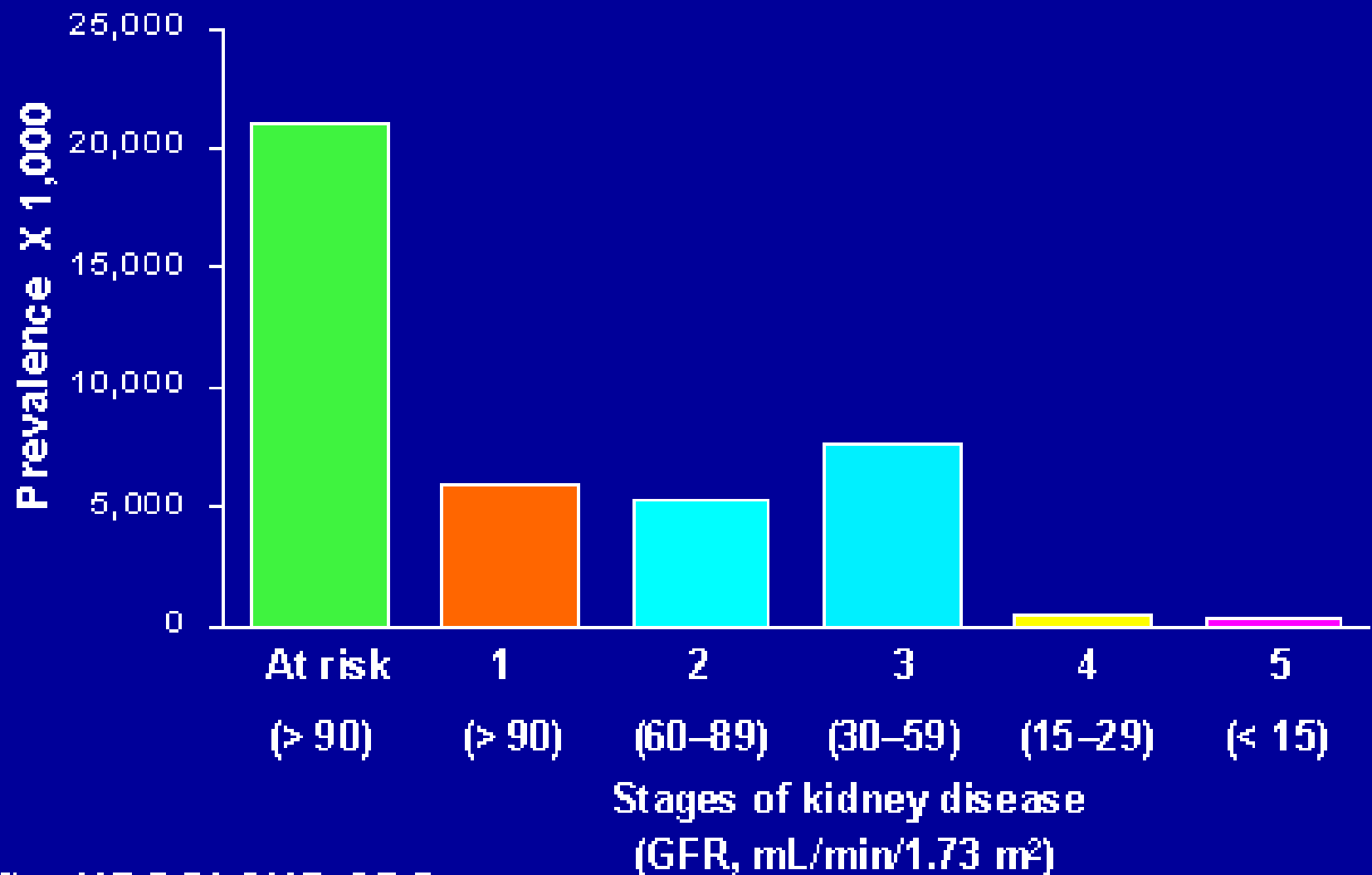
B = black; W = all ethnic groups other than black; *With evidence of kidney damage.

The Prevalence of CKD is High

NKF-K/DOQI Estimates of Prevalence of CKD in the U.S.

Stage	Description	GFR (ml/min/1.73 m ²)	Prevalence (000s)	Prevalence (%)
1	Kidney Damage with Normal or ↑ GFR	>90	5900	5.8
2	Mild ↓ GFR	60-89	5300	3.0
3	Moderate ↓ GFR	30-59	7600	4.3
4	Severe ↓ GFR	15-29	400	0.2
5	Kidney Failure	<15 or Dialysis	300	0.1

Stages And Prevalence Of Chronic Kidney Disease



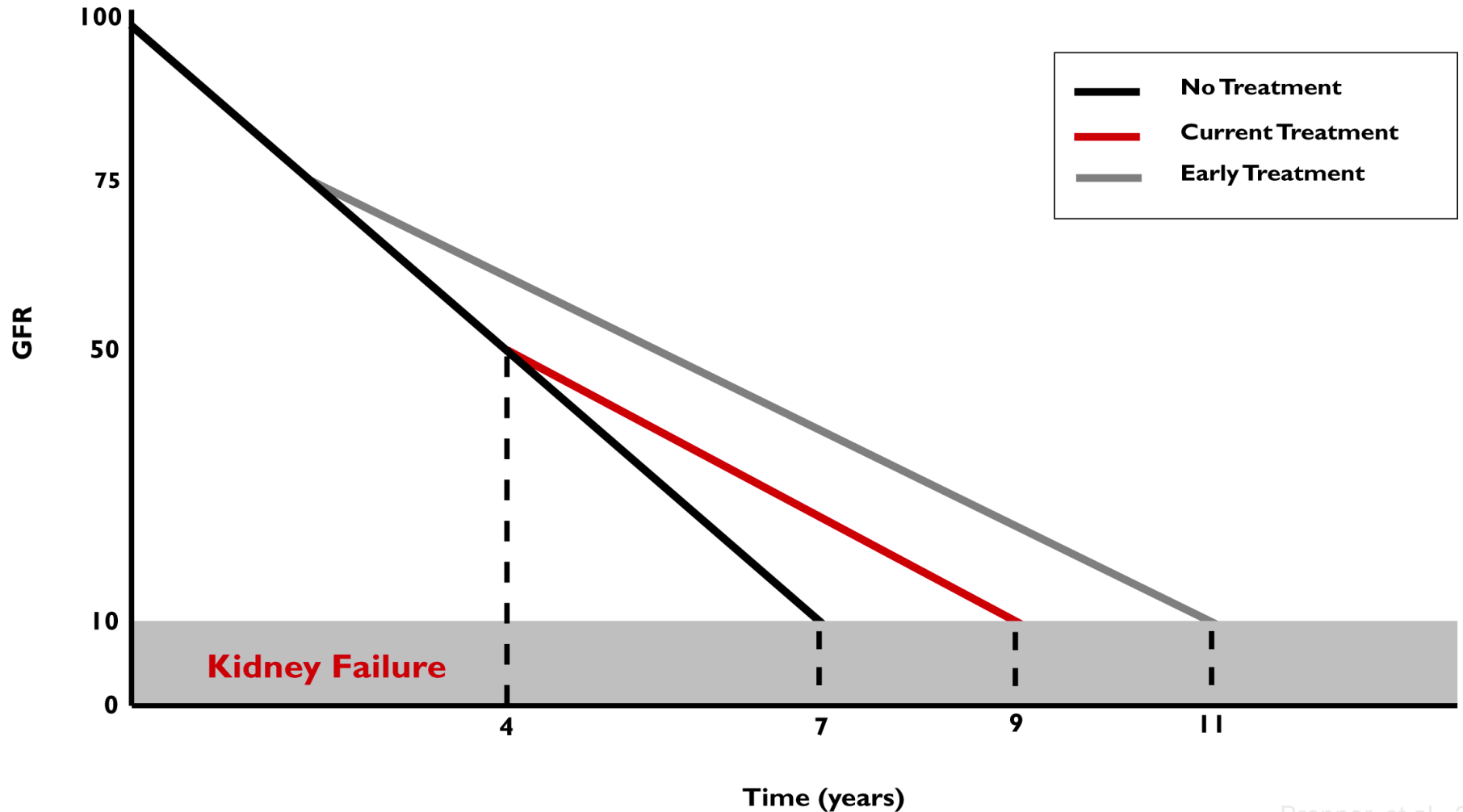
After KDOQI CKD CPG.

Summary

Clinical Action Plan for Chronic Kidney Disease

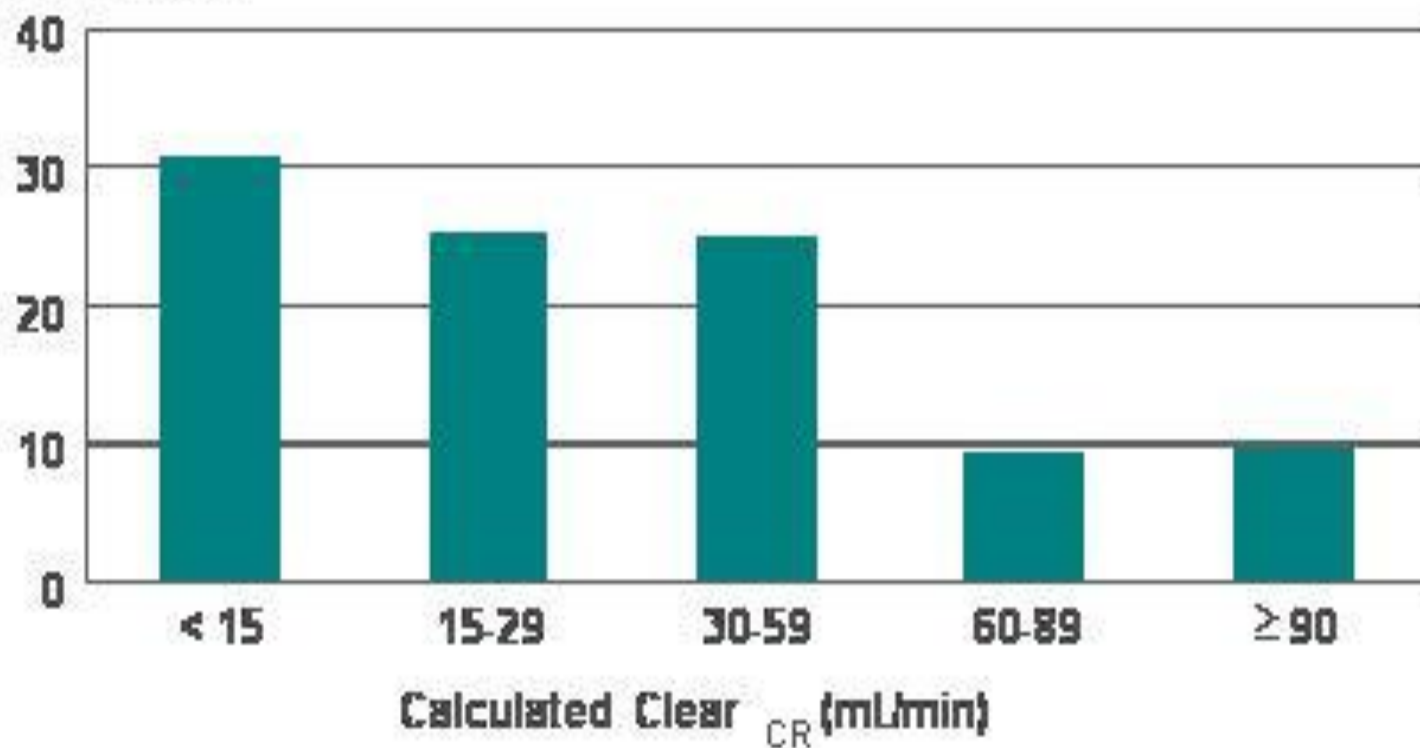
Stage	Description	GFR (ml/min/1.73 m ²)	Action Plan (build at each stage)
	At Increased Risk	>90 (CKD Risk Factors)	Screening, CKD Risk Reduction
1	Kidney Damage with Normal or ↑ GFR	>90	Diagnosis and Treatment, Slowing Progression CVD Risk Reduction
2	Mild ↓ GFR	60-89	Estimating Progression
3	Moderate ↓ GFR	30-59	Evaluating and Treating Complications
4	Severe ↓ GFR	15-29	Preparation for Kidney Replacement Therapy
5	Kidney Failure	≤15 or Dialysis	Replacement, if Uraemia Present

Early Treatment Makes a Difference



Kidney Function at Time of Referral

% of Patients



Total n = 718

CKD Is Not Adequately Recognized and Not Treated Early

- Most practices screen fewer than 10% of their Medicare patients who have diabetes, the single biggest risk factor for CKD
- Patients are referred late to a nephrologist, especially African-American men, who are at high risk for CKD
- Less than 1/3 of people with identified CKD get an ACE Inhibitor to control their blood pressure—and high blood pressure is a major risk factor for CKD
- Nearly 50% of HD patients do not receive Vitamin D replacement therapy, and the Vitamin D use in Stage 3-4 is well under 50%, despite the known protective effects of Vitamin D in kidney disease

Kidney Function Differs significantly by Referring MD Specialty

% of Patients

Calculated Creatinine Clearance (mL/min)

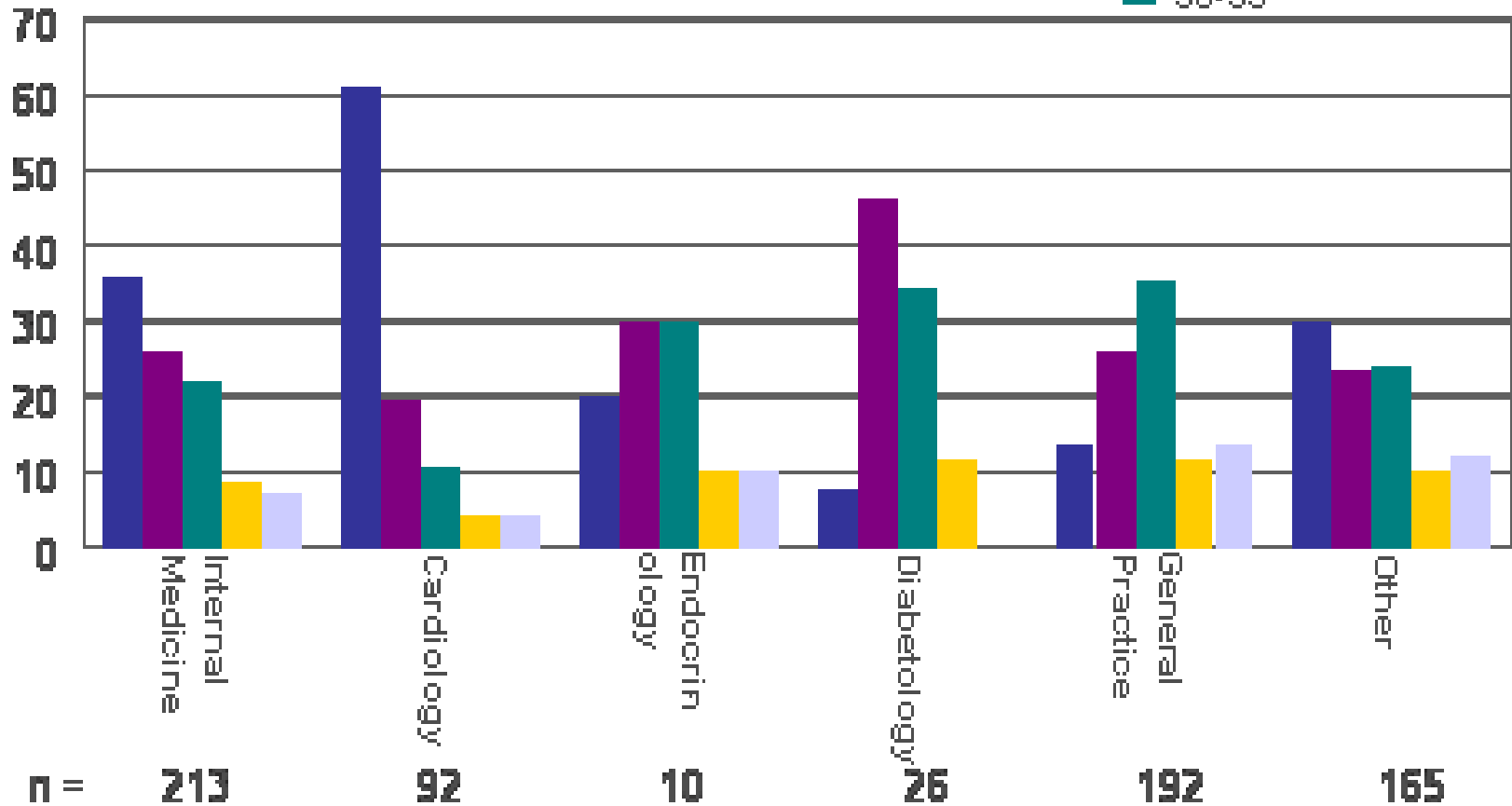
< 15

15-29

30-59

60-89

≥ 90



Chi Square=11.82, df=20, p<0.001

EVALUATION OF CKD

Evaluation Of CKD: Causes

- Diabetes mellitus ~**50%**
look for microalbuminuria, retinopathy, long history
- Hypertension ~**30%**
look for poor BP control, family history of CKD, proteinuria – but never nephrotic syndrome
- Glomerular Disease
hematuria, RBC casts, nephrotic range proteinuria
- Obstruction
BPH symptoms; Gyn or GI cancers, hematuria, freq. UTI's
- Medications
interstitial nephritis and other disorders

Which Patients Should Be Screened for CKD?

Susceptibility Risk Factors	Progression Factors
<ul style="list-style-type: none">• Diabetes• Hypertension• Older age• Family history of nephropathy• Racial or ethnic minority• Other<ul style="list-style-type: none">– Low income/minimal education– Reduction in kidney mass– Known kidney disease	<ul style="list-style-type: none">• Higher level of proteinuria• Higher BP• Poor glycemic control• Smoking• Hyperlipidemia• Drug use

Evaluation Of CKD: Laboratory workup

For all patients with CKD or increased risk for CKD, evaluate

- Estimated GFR (eGFR)*
 - Calculate annually from serum creatinine (SCr), age, gender, and race
 - Automatic calculator available at: www.kidney.org
- Urine examination
 - Examine the urine sediment or dipstick for erythrocytes and leukocytes
 - Albumin:creatinine ratio in random, untimed urine specimen
 - Microalbuminuria is 30-299 mg Alb/g Cr
 - Clinical albuminuria is ≥ 300 mg Alb/g Cr
 - Begin screening at the time of type 2 diabetes diagnosis
 - Begin screening at 5 years for type 1 diabetes

GFR: Measurement vs Estimate

- Measured 24-hour urine collection for creatinine Clearance

- Formulas for estimating GFR

- Cockcroft-Gault

$$\text{mL/min} = \frac{(140 - \text{age}) (\text{wt})}{72 \times \text{SCr}} \times 0.85 \text{ if female}$$

- MDRD (A PDA version can be obtained at this NKF web site)

www.kidney.org/professionals/kdoqi/cap.cfm

$$\text{mL/min/1.73 m}^2 = 170 \times (\text{SCr})^{-0.999} \times (\text{age})^{-0.176} \times (\text{BUN})^{-0.170} \times (\text{Alb})^{0.318} \times (0.762 \text{ if female}) \times (1.180 \text{ if black})$$

Evaluation of CKD

- Estimate GFR with MDRD calculation, urinalysis and micro, spot urine for protein/creat ratio or microalbumin/creat ratio if diabetic
- Renal ultrasound
 - Two kidneys; no obstruction; no masses
 - Asymmetric size suggests renovascular disease
- Is patient over age 50 or very anemic?
 - Check SPEP, UPEP to r/o multiple myeloma
- Is renal function stable?
 - Frequent creatinine check, until stability clear

Evaluation Of CKD

Refer to a nephrologist if :

- you are uncomfortable with diagnosis
- diagnosis may be a GN
 - ... > 3 grams protein in a non-diabetic
 - ... an active urine sediment
- renal function declining rapidly

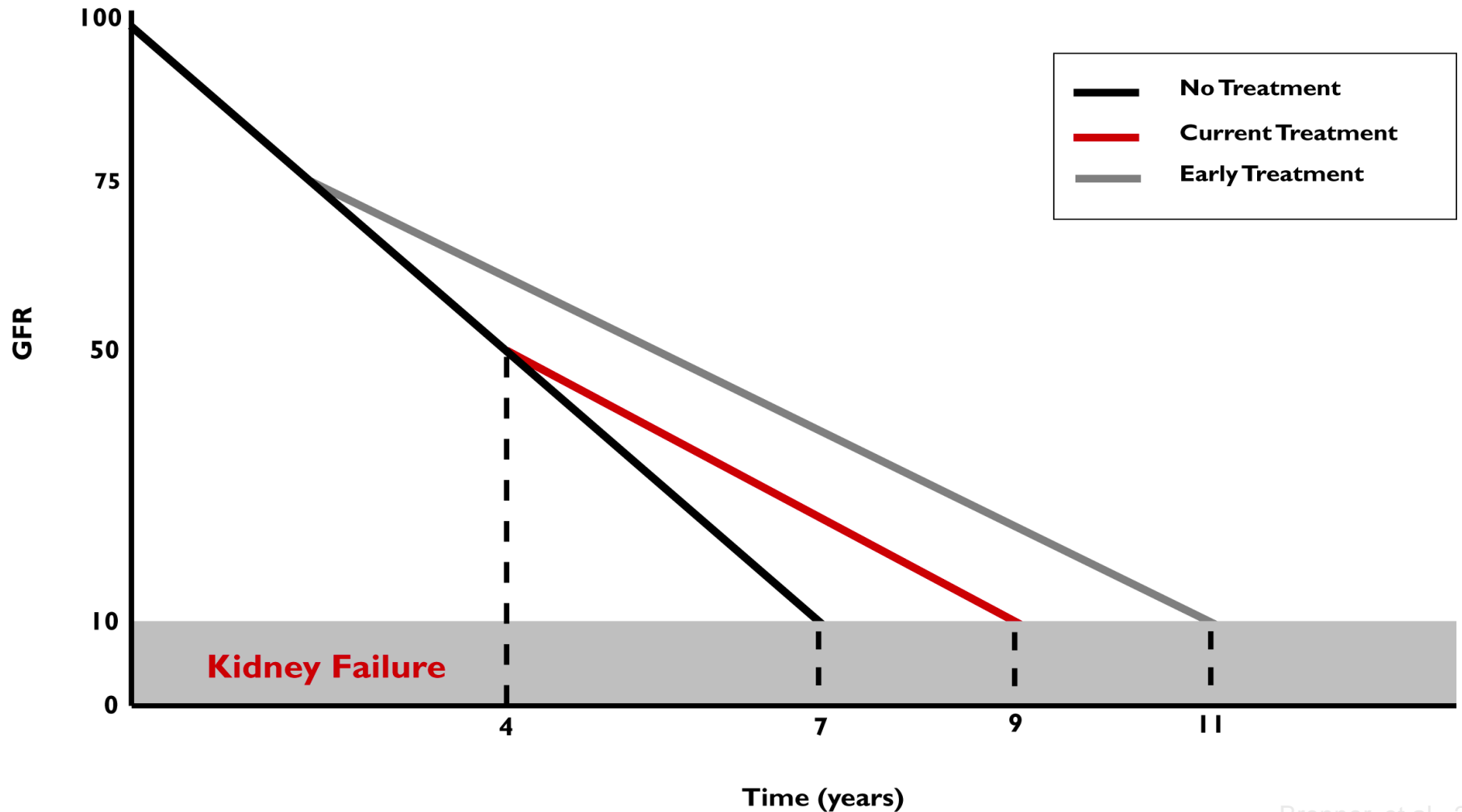
MANAGEMENT OF EARLY CKD

STAGE 1 & 2

Management Of CKD (Stage 1 & 2)

- eGFR: normal to 60 ml/min
- Identify presence and cause of CKD
- Risk factors for progression
 - Hypertension
 - Proteinuria
 - Poor glucose control
- Assess and address cardiovascular risk factors
 - Lipids & Smoking cessation

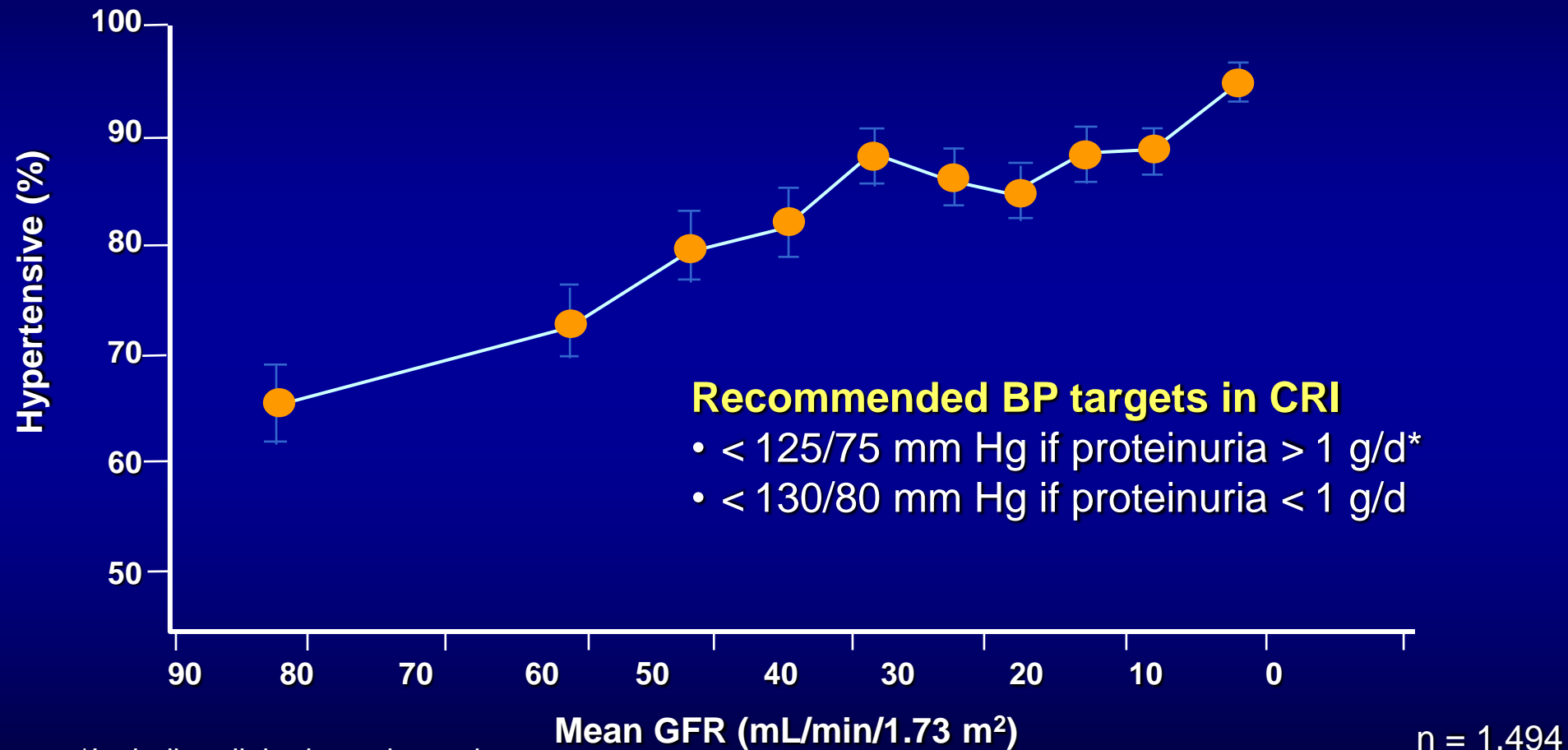
Early Treatment Makes a Difference



Management Of CKD

Hypertension

Hypertension Develops Early And Progresses In CKD

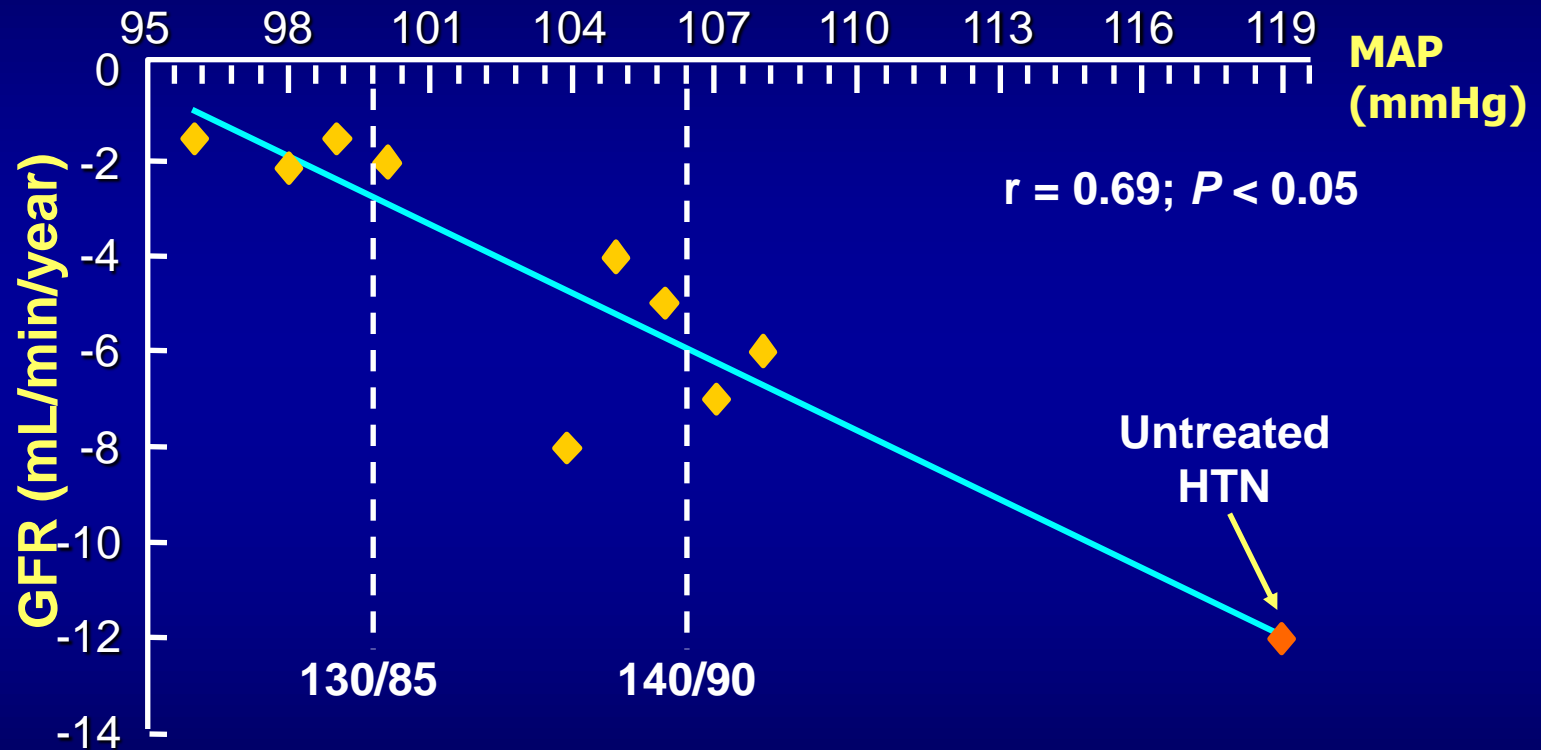


*Including diabetic nephropathy.

Buckalew et al. *Am J Kidney Dis.* 1996;28:811-821.

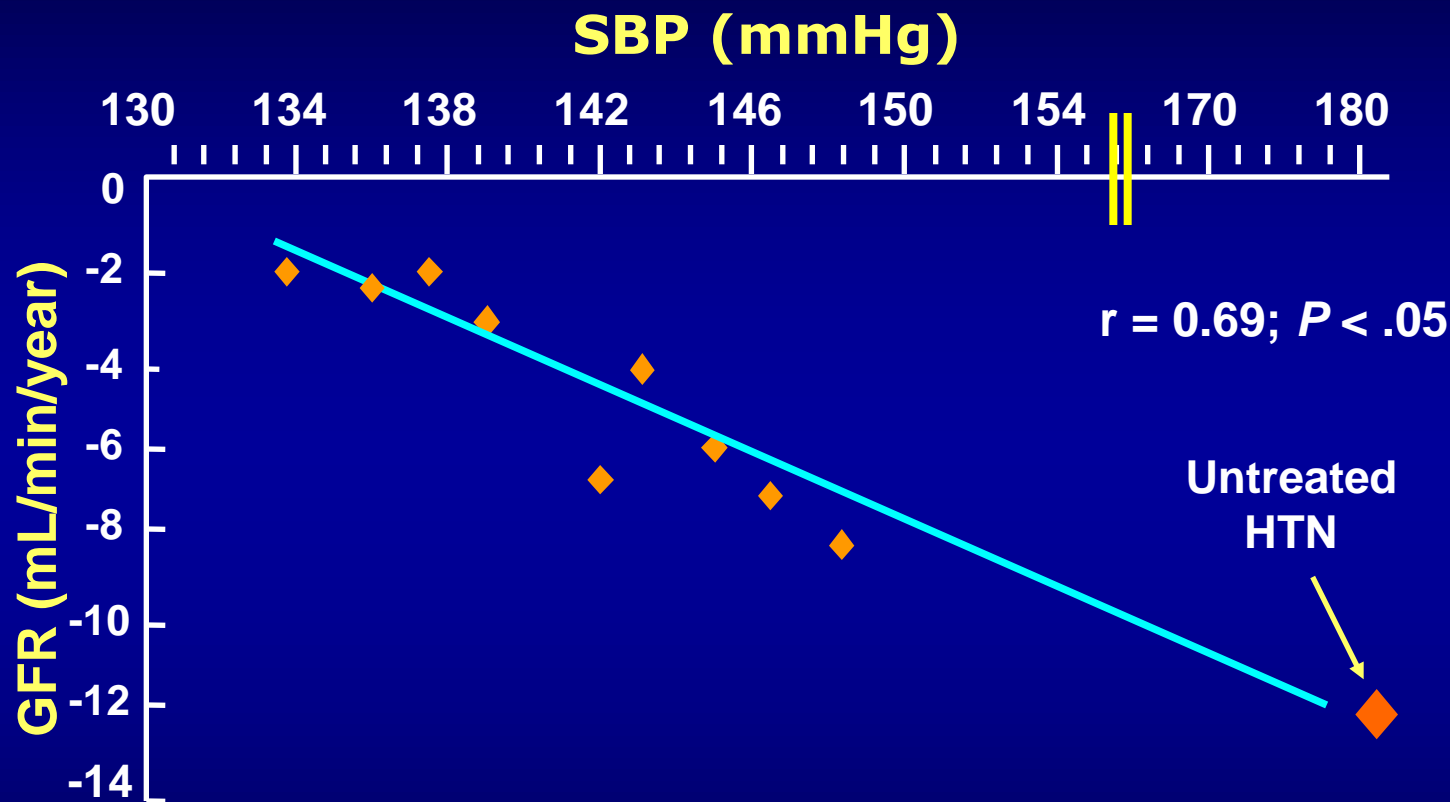
Levey et al. *Am J Kidney Dis.* 1998; 32:853-906.

Meta Analysis: Mean BP Achieved And Rate Of Decline In GFR In Diabetics And Non-diabetics



Bakris GL, et al. Am J Kidney Dis.
2000;36(3):646-661.
Reprinted by permission, Harcourt Inc.

Meta Analysis: Systolic BP Achieved And Rate Of Decline In GFR In Diabetics And Non-diabetics



Bakris GL, et al. Am J Kidney Dis.
2000;36(3):646-661.

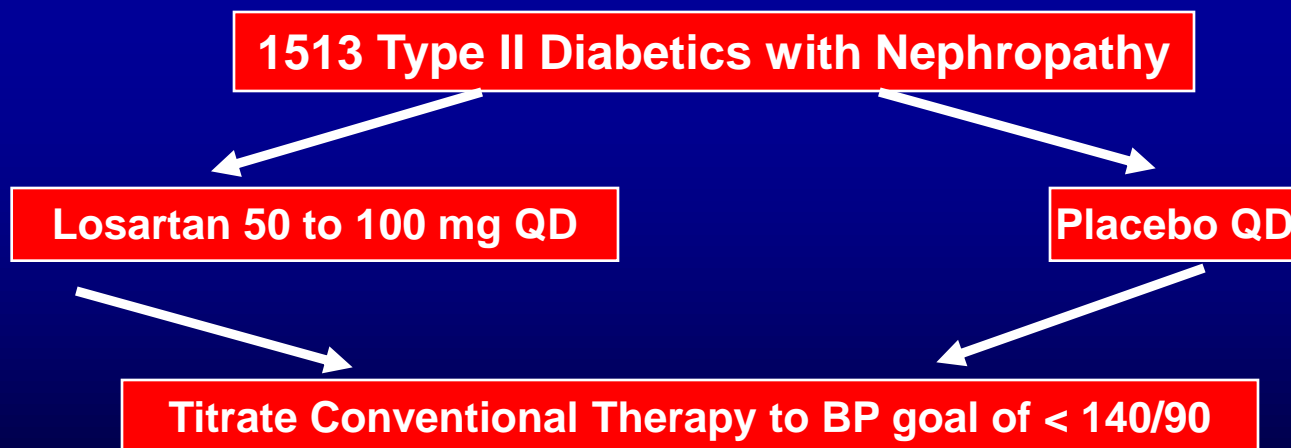
Drugs for hypertension

- ACE inhibitors, especially if proteinuria
- Diuretics
- ACE inhibitor/diuretic combination
- Angiotension receptor blocker, especially if proteinuria
- Calcium channel blockers
 - Non-DHP preferable if proteinuria present
 - DHP
- Beta blockers
- Others

ARB's In Type II Diabetic Nephropathy

RENAAL (Losartan Trial)

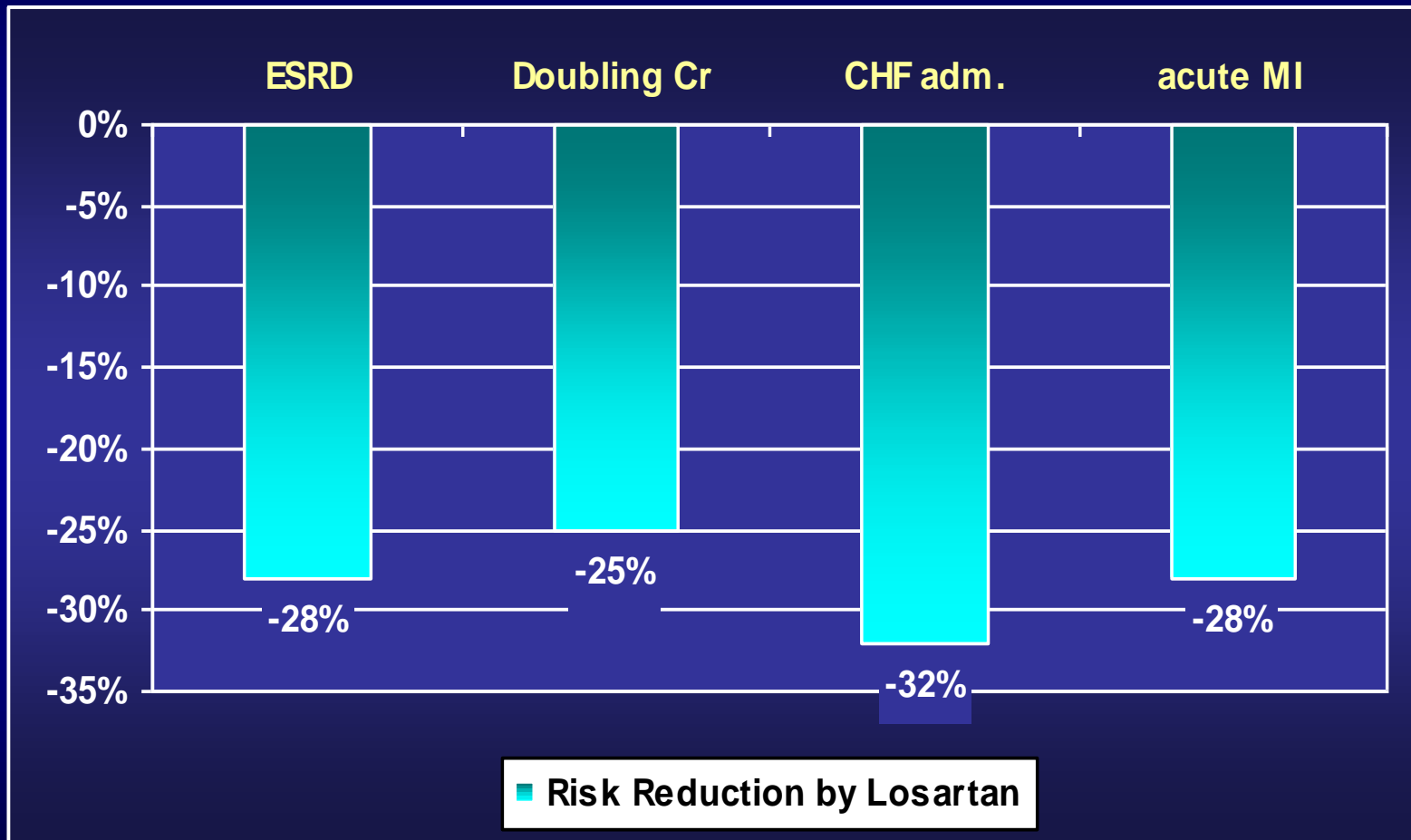
- Multinational, randomized, double-blinded, placebo-controlled study in 1513 type 2 diabetics with nephropathy (Cr 1.5 – 3.0)
- Primary hypothesis: an ARB with conventional BP meds delays ESRD, or death more than placebo with conventional BP meds



Average follow-up of 3.4 years

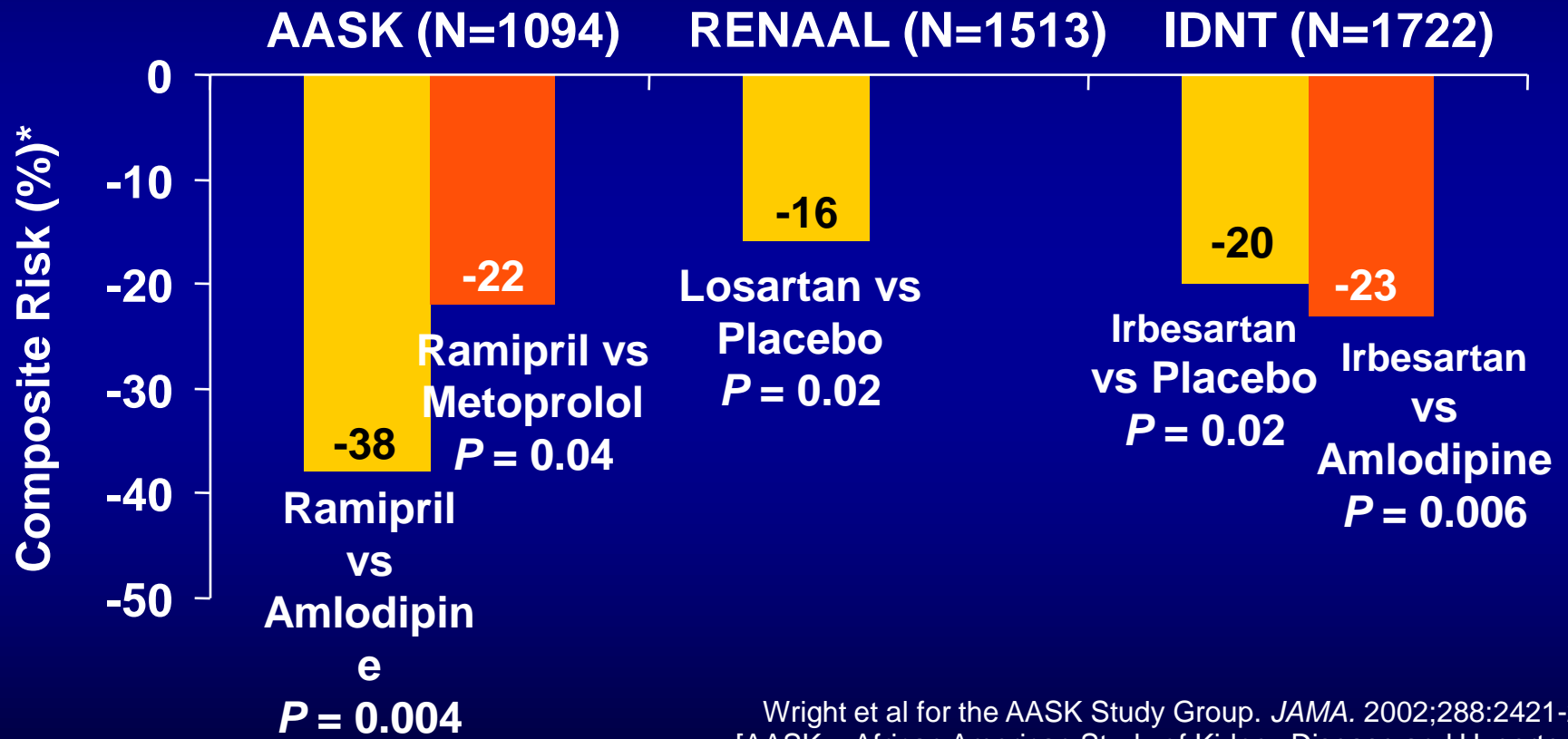
ARB's in Type II Diabetic Nephropathy

RENAAL (Losartan trial)



BP control was not significantly different between the groups

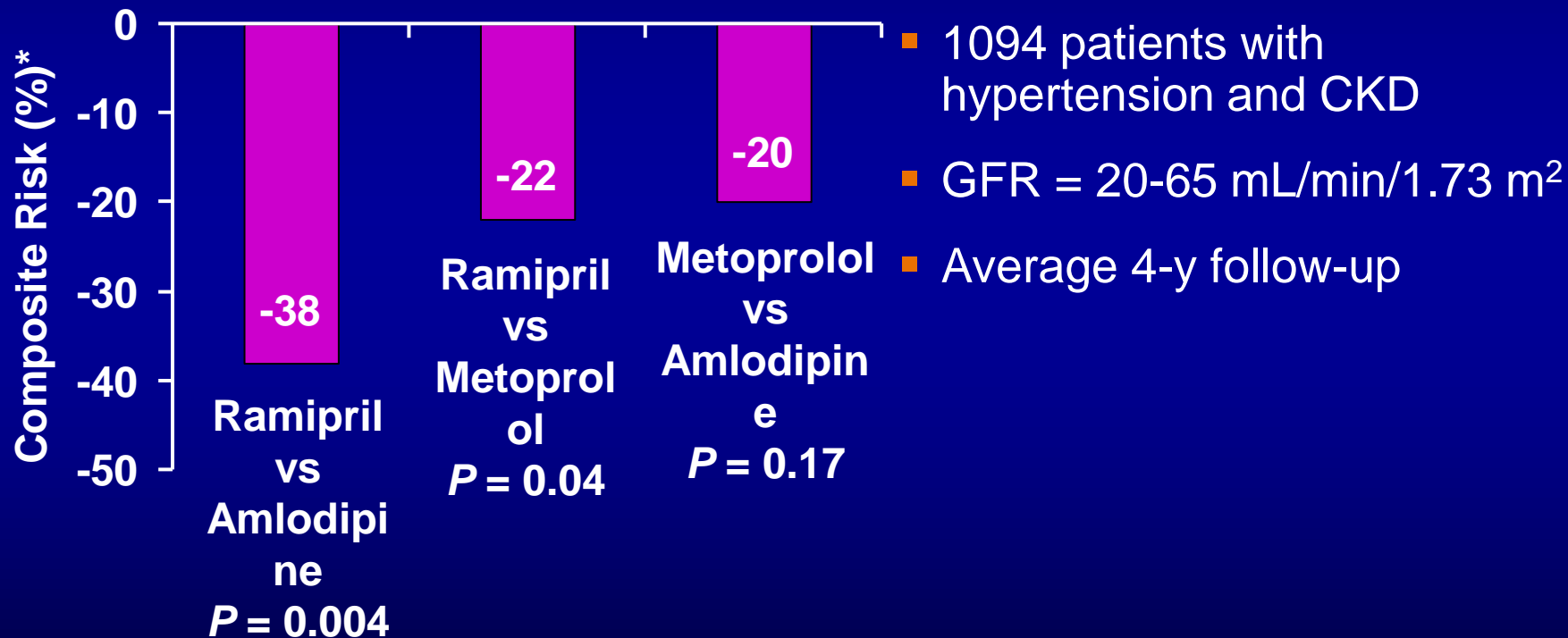
ACEI/ARB & Reduced Risk of Rapid GFR Decline, Kidney Failure, or Death



Wright et al for the AASK Study Group. *JAMA*. 2002;288:2421-2431.
 [AASK - African American Study of Kidney Disease and Hypertension]
 Brenner et al for the RENAAL Study Investigators. *N Engl J Med*. 2001;345:861-869.
 [RENAAL = Reduction of Endpoints in NIDDM with the Angiotensin II Antagonist Losartan]
 Lewis et al for the Collaborative Study Group. *N Engl J Med*. 2001;345:851-860.
 [IDNT = Irbesartan in Diabetic Nephropathy Trial.]

Evidence for Reduced Risk of CKD Progression With ACEI Therapy

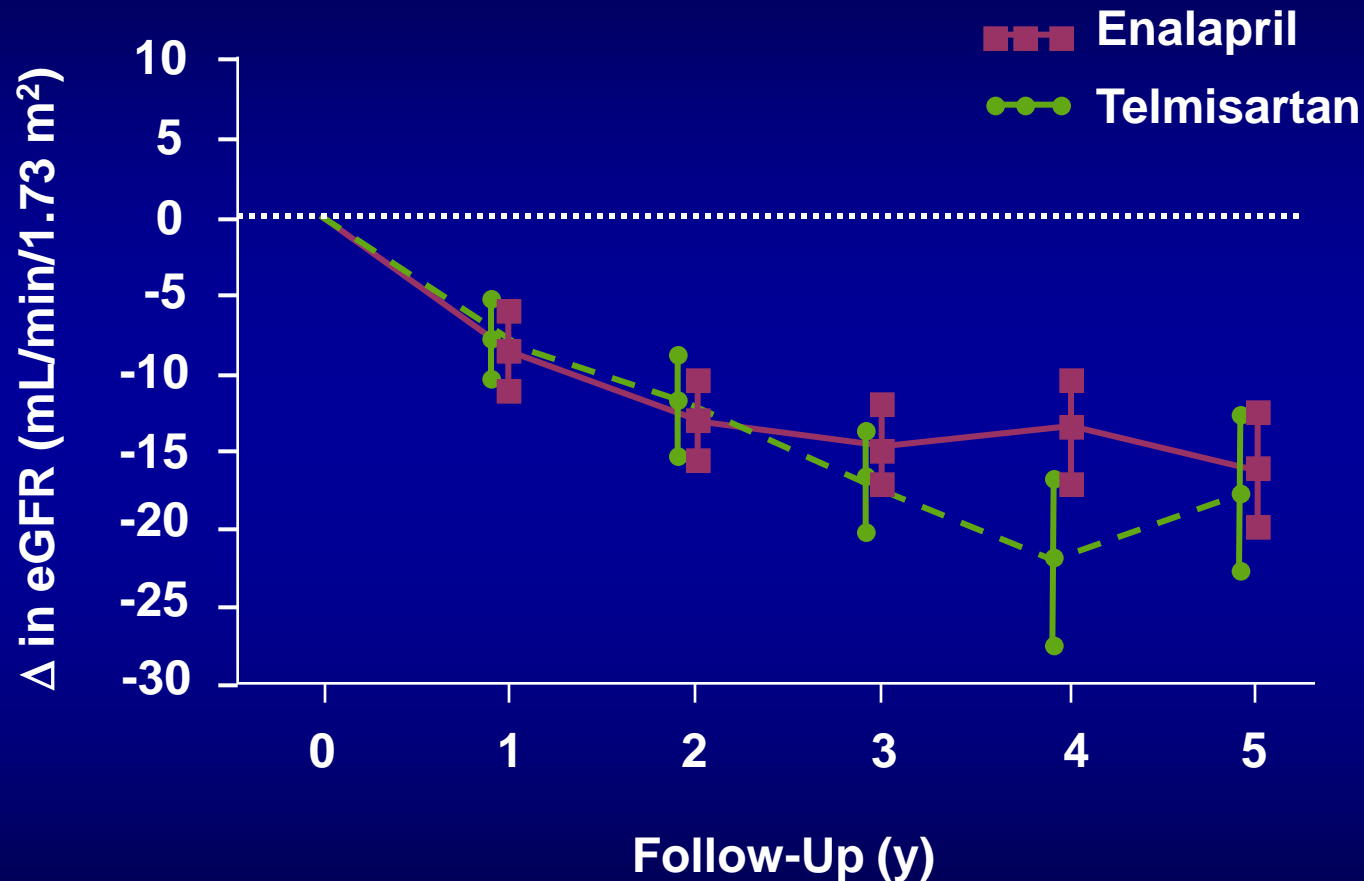
African American Study of Kidney Disease and Hypertension (AASK)



ACEI = angiotensin-converting enzyme inhibitor.*Composite risk of rapid GFR decline/decrease from baseline of 50% or 25 mL/min/1.73 m², kidney failure, or death in patients with existing kidney damage.

Wright et al for the AASK Study Group. JAMA. 2002;288:2421-2431.

ACEIs or ARBs Effective for Patients With Type 2 DM

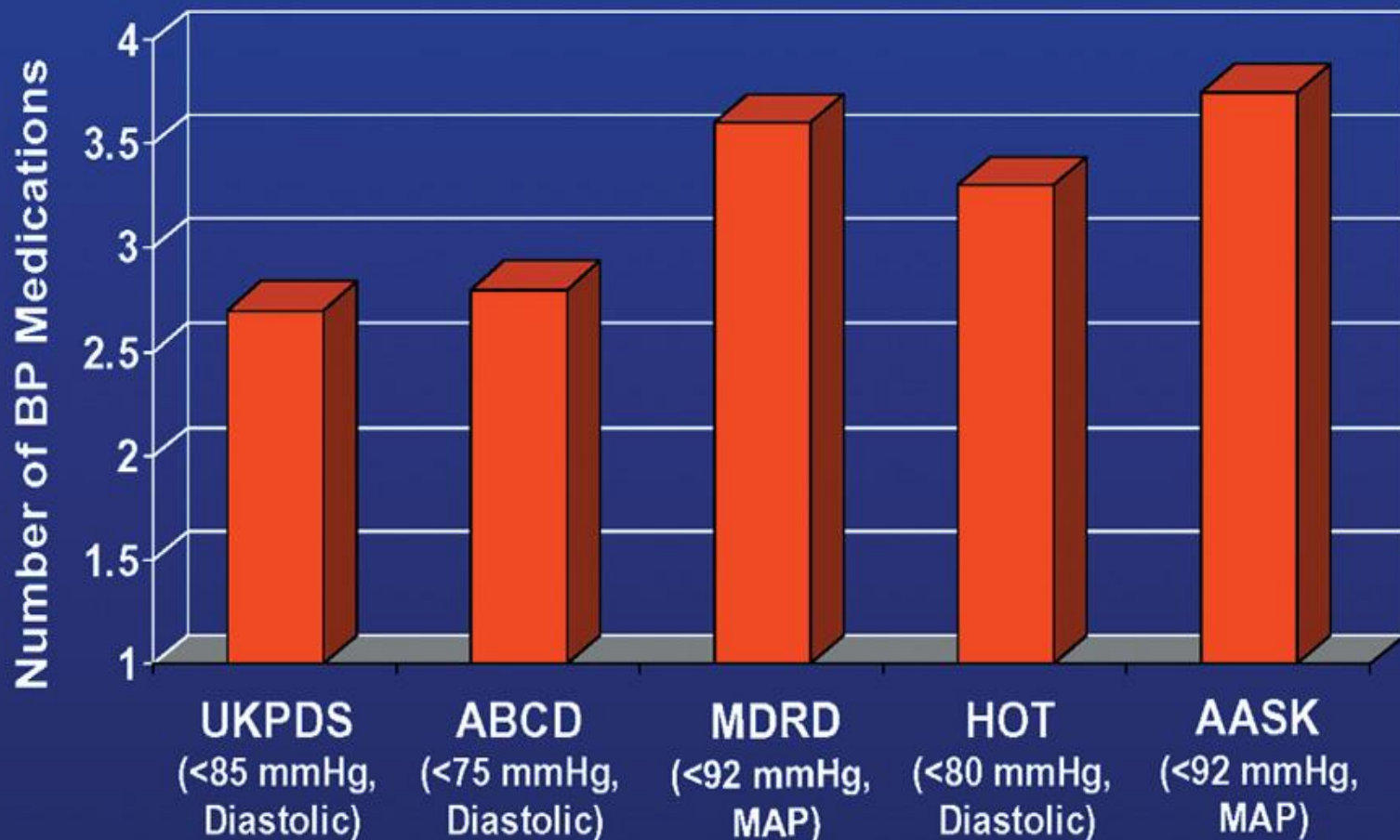


N = 250. Changes from baseline eGFR, based on 5-y data according to treatment group of enalapril or telmisartan in patients with type 2 diabetes and nephropathy.

ARB = angiotensin II receptor blocker.

Barnett et al. *N Engl J Med*. 2004;351:1952-1961.

Number of Antihypertensive Agents Used to Achieve Target BP



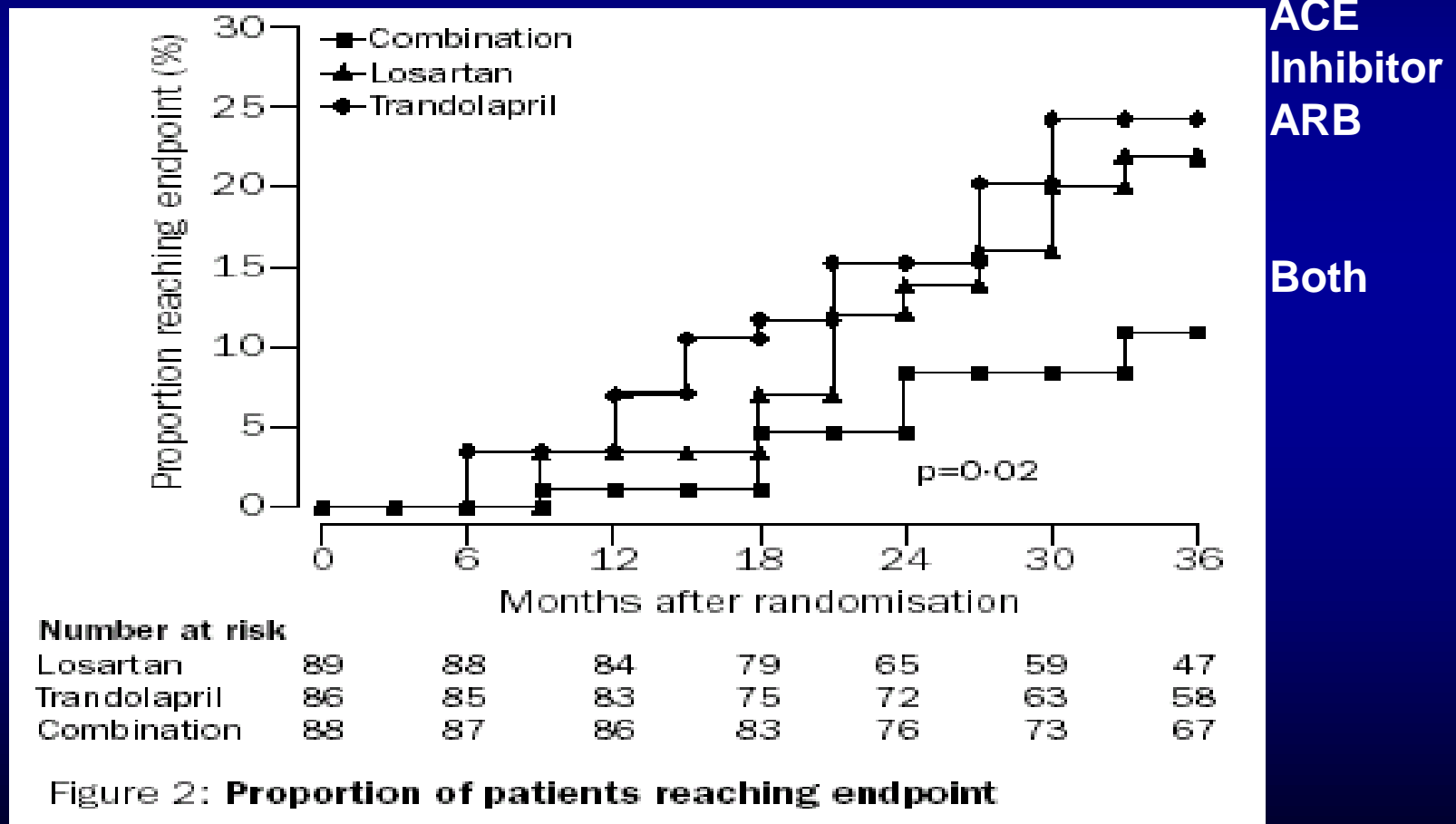
UKPDS=United Kingdom Prospective Diabetes Study, ABCD=Appropriate Blood Pressure Control in Diabetes, MDRD=Modification of Diet in Renal Disease, HOT=Hypertension Optimal Treatment, AASK=African-American Study of Kidney disease and hypertension.

Management Of CKD

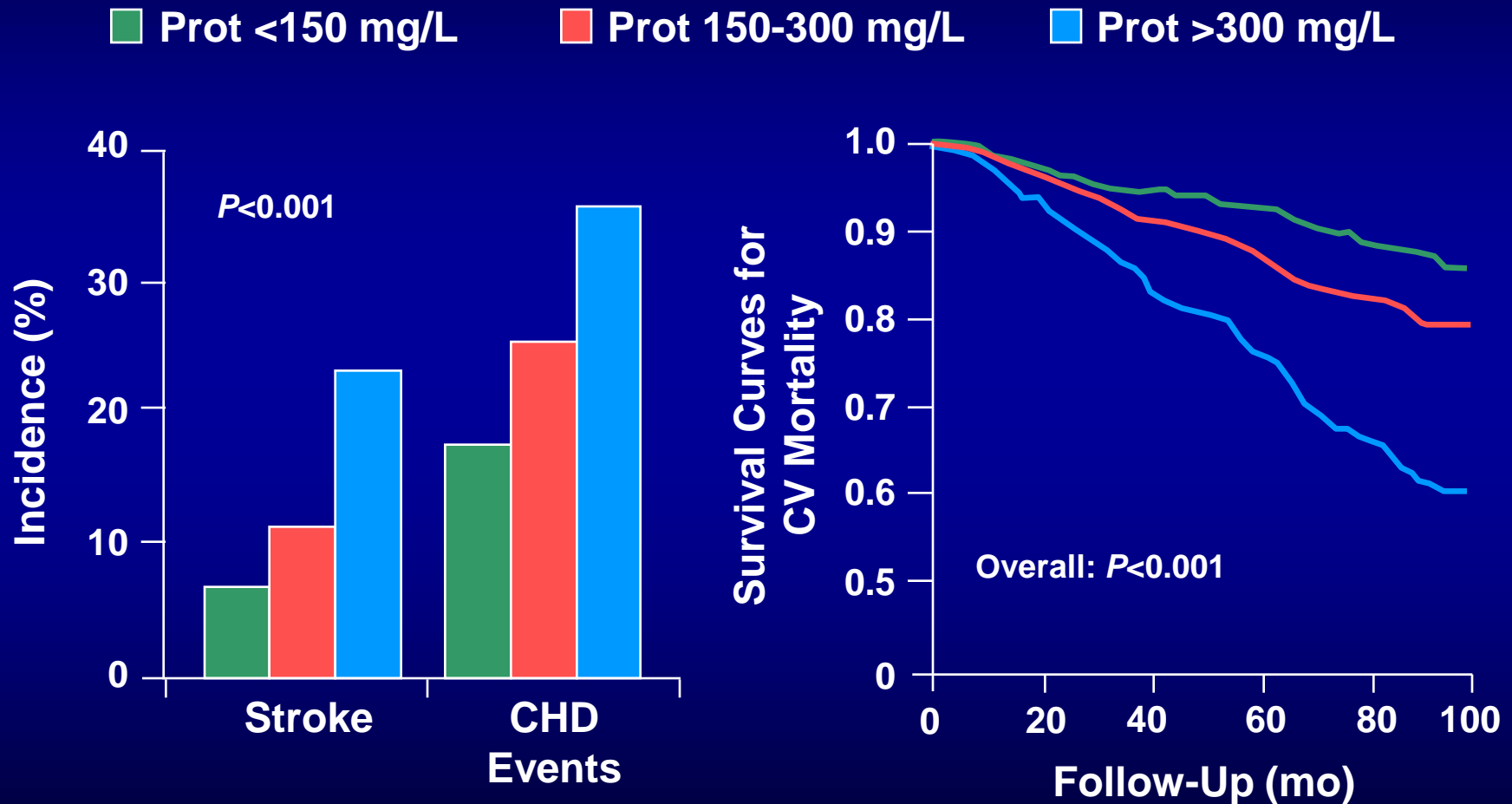
Proteinuria

Management Of CKD: Proteinuria

- **Combined endpoint: doubling creatinine or est. GFR <7 ml/min**



Proteinuria Predicts Stroke and CHD Events in Patients With Type 2 Diabetes



CHD = coronary heart disease; Prot = urinary protein excretion.

Miettinen et al. *Stroke*. 1996;27:2033-2039.

Goals for Glycemic Control in Diabetes

Parameter	Goal	
	ACE/AACE ¹	ADA ²
A1C	≤6.5% (normal, 4%-6%)	<7%
Preprandial plasma glucose	<110 mg/dL	90-130 mg/dL
Postprandial plasma glucose	<140 mg/dL*	<180 mg/dL [†]

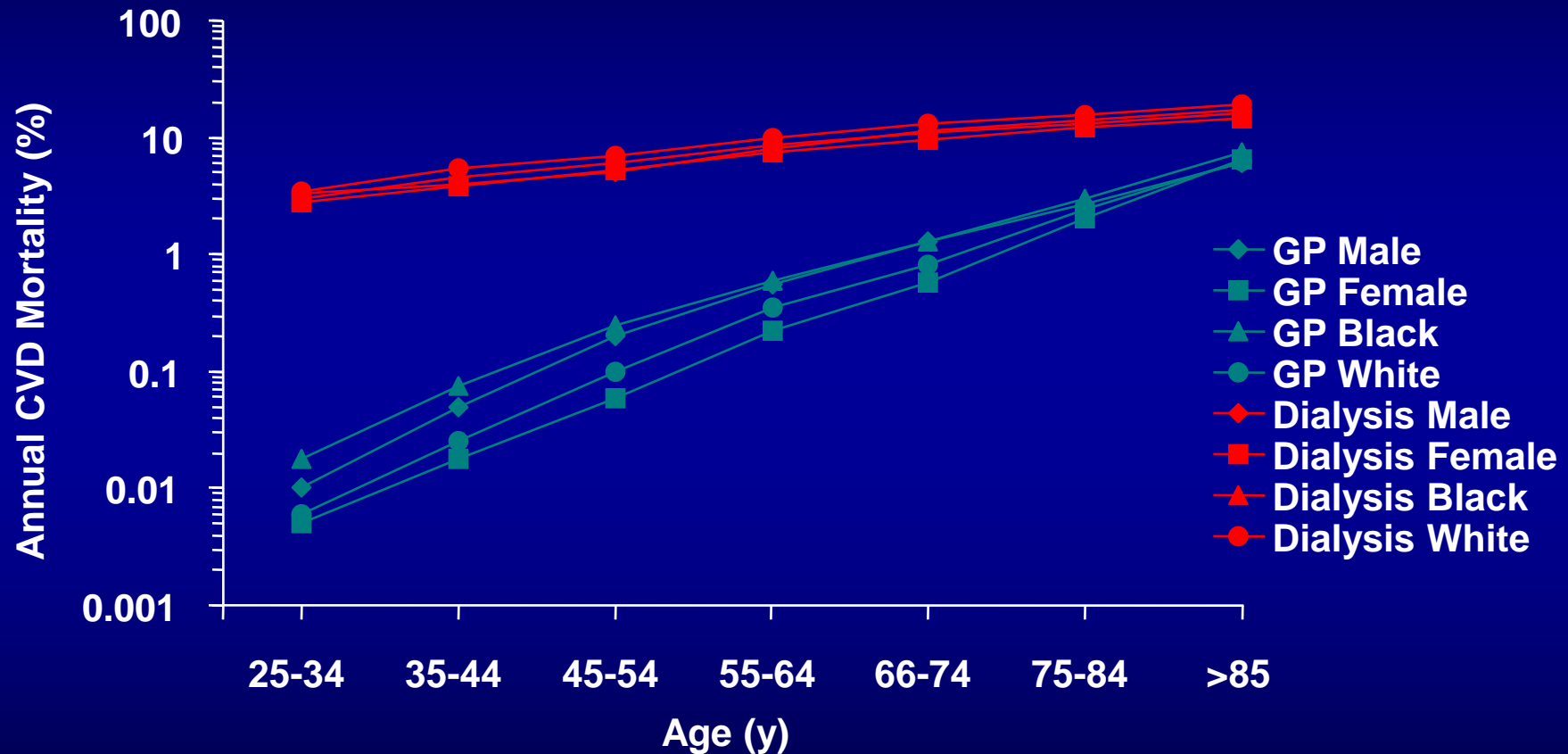
A1C = glycosylated hemoglobin; ACE = American College of Endocrinology; AACE = American Association of Clinical Endocrinologists; ADA = American Diabetes Association.

*

Management Of CKD

Hyperlipidemia

Cardiovascular Disease Mortality Is Increased in Patients on Dialysis



CVD = cardiovascular disease; CKD = chronic kidney disease; GP = general population.

Foley et al. *Am J Kidney Dis*. 1998;32(suppl 3):S112-S119.

Incidence of Cardiovascular Disease (CVD) and Rate of Renal Function Loss in Stages 1 to 3 of CKD

- Compared the incidence rates of CVD in subjects with stages 1-3
- Data from PREVEND study, an observational cohort study performed in the Netherlands

- **Prevalence and Demographics of CKD and CVD in Stages 1-3**
- Median follow-up was 7.3 yrs

	No CKD	Stage 1	Stage 2	Stage 3
N	6906	243	856	491
Age, yr (SD)	47 (12)	48 (12)	56 (12)	63 (9)
Male, %	49	66	64	38
Incidence Rates of CVD	7.1	16.9*	22.8*	22.5*
Age and sex-adjusted Hazard Ratio for CVD	Ref	2.2 (1.5-3.2)	1.6 (1.3-2.0)	1.3 (1.0-1.7)

Outcomes Based on Presence of Microalbuminuria (MA)

	Stage 3, MA -	Stage 3, MA +
Hazard Ratio for CVD	1.0 (0.7-1.5)	1.7(1.2-2.4)
Annual Change in eGFR during follow-up (mL/min/1.73m2/yr)	+0.16±1.22	-0.50±1.21**

Conclusions:

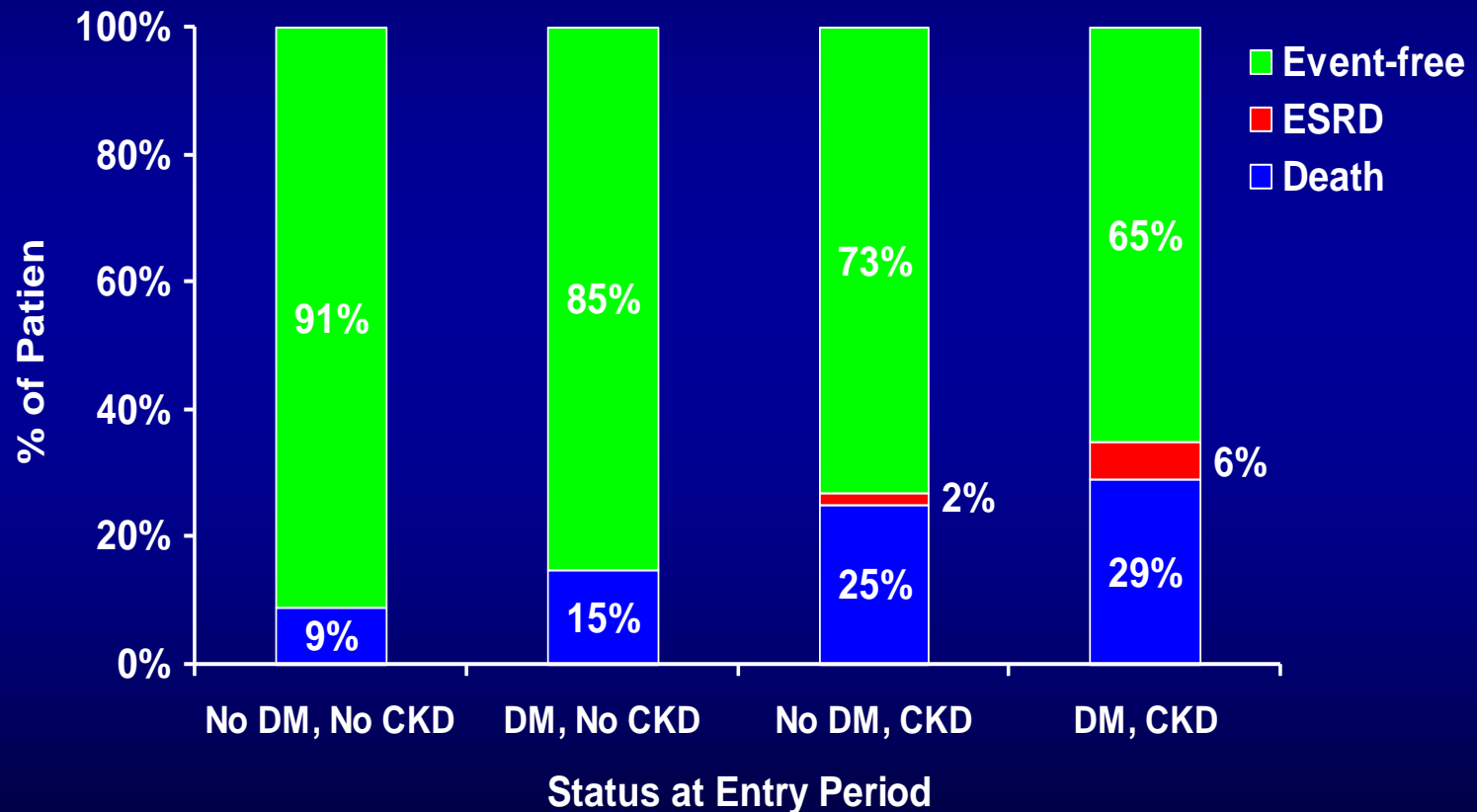
- Screening for stages 1 and 2 successfully detects subjects at risk for CVD
- For defining stage 3 CKD, an additional criterion determining presence of MA may be needed

*p<0.001, compared to No CKD

**p<0.001, compared to Stage3, MA-

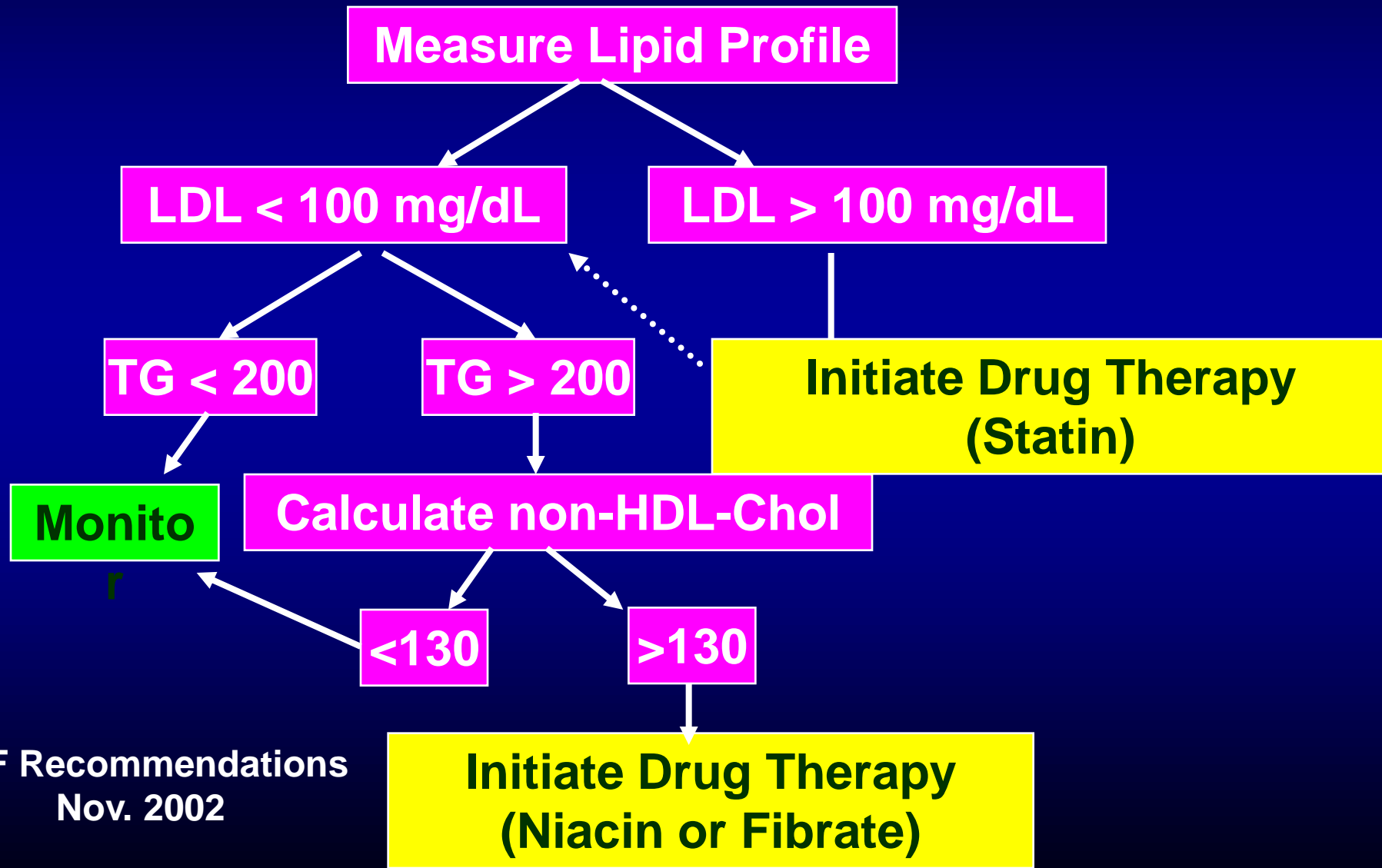
CKD Patients Are More Likely To Die Than Progress To ESRD

Percentage Who Remained Event-free Vs Death Vs Developed ESRD During 2-year Follow-up



Medicare 5% sample 1996-1997, 2-year follow-up, adjusted for age, gender, and race.
Analysis performed by Minneapolis Medical Research Foundation.

Lipid Management Targets In CKD



Stage 3 CKD
eGFR 30 – 59 ml/min

Common Adjustments In Stage 3 CKD

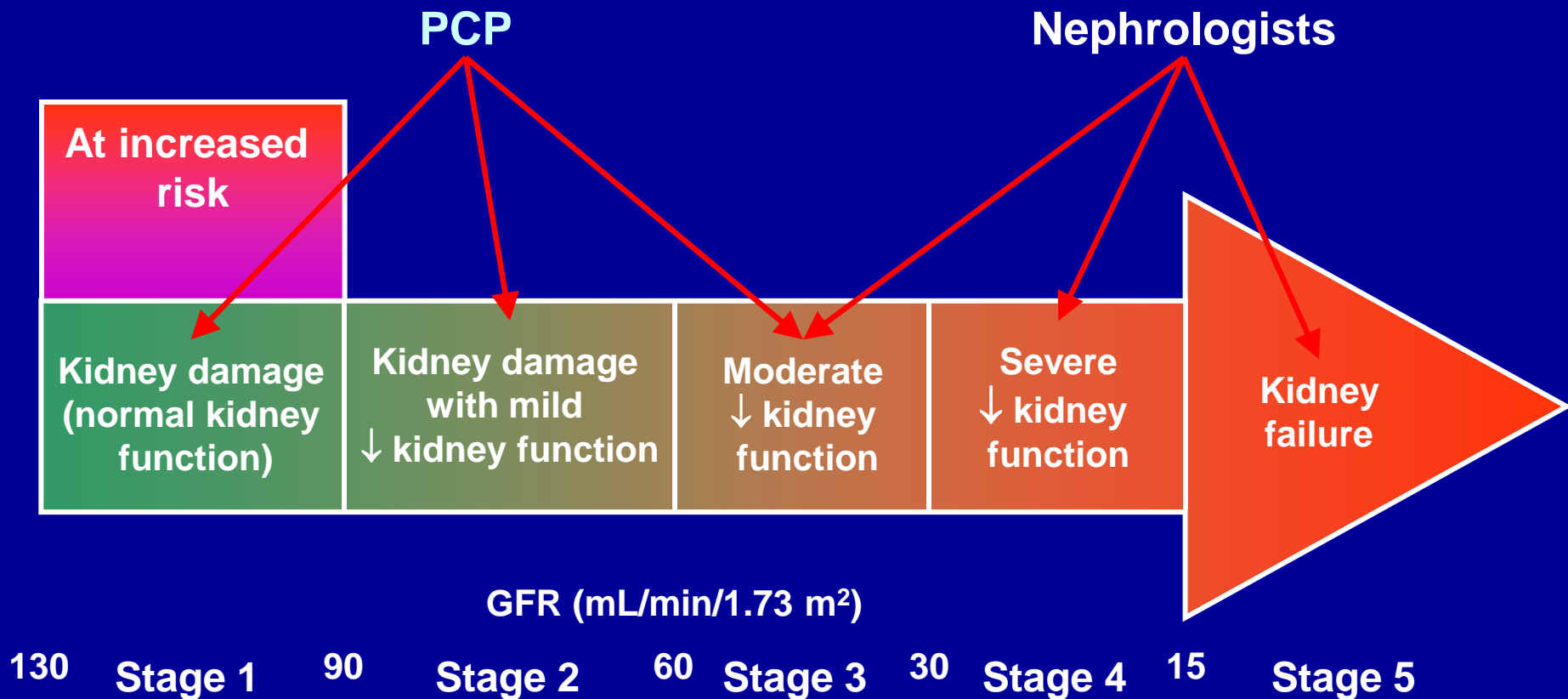
GFR 30 To 59 ml/min

- Convert HCTZ to Furosemide to maintain diuresis.
- Stop K⁺ sparing diuretics.
- Reduce Allopurinol from 300 mg/d to 200 mg/d.
- Stop Glucophage (do not use in stage 2 CKD or Scr >1.5mg/dl)
- Avoid all NSAIDs.
- Assess new drugs for renal dose adjustment.
- Refer all patients to nephrology when GFR below 30 ml/min.








Summary Of Management Objectives

- Screen at-risk population for CKD
- If diabetic, control A_{1c} to $< 7\%$
- Reduce BP to $<130/80$ mmHg, $<125/75$ if CKD present
- Use multiple antihypertensive drugs
- Monitor for maximal reduction of proteinuria
- Treat hyperlipidemia ($LDL < 100$ mg/dl) & stop smoking
- Enteric coated aspirin 81-325 mg/day
- Low salt diet ($NaCl < 2$ g/day)

Co-Management



CKD Clinical Action Plan

	Stages 1-2 ¹ GFR >60 mL/min/1.73 m ²	Stage 3 ¹ GFR 30-59 mL/min/1.73 m ²	Stage 4 ¹ GFR 15-29 mL/min/1.73 m ²	Stage 5 ¹ GFR <15 mL/min/1.73 m ²
BP<130/80 mm Hg ²				
ACEI/ARB ²				
Dyslipidemia ²				
Bone mineral (PTH, Ca, P) ²				
Active Vitamin D Therapy ¹				
Anemia ²				
Vascular access ²				

ACEI/ARB=angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker

1. National Kidney Foundation. *Am J Kidney Dis.* 2003;42:1-201.
2. Modified from Levey et al. *Ann Intern Med.* 2003;139:137-147.

SUMMARY

- CKD is very common
- CKD populations are easily identifiable and accessible
- Guidelines for prevention & management of CKD available
- CKD care can be improved
- CKD patients are at high risk for cardiovascular disease
- Development of ESRD can be delayed

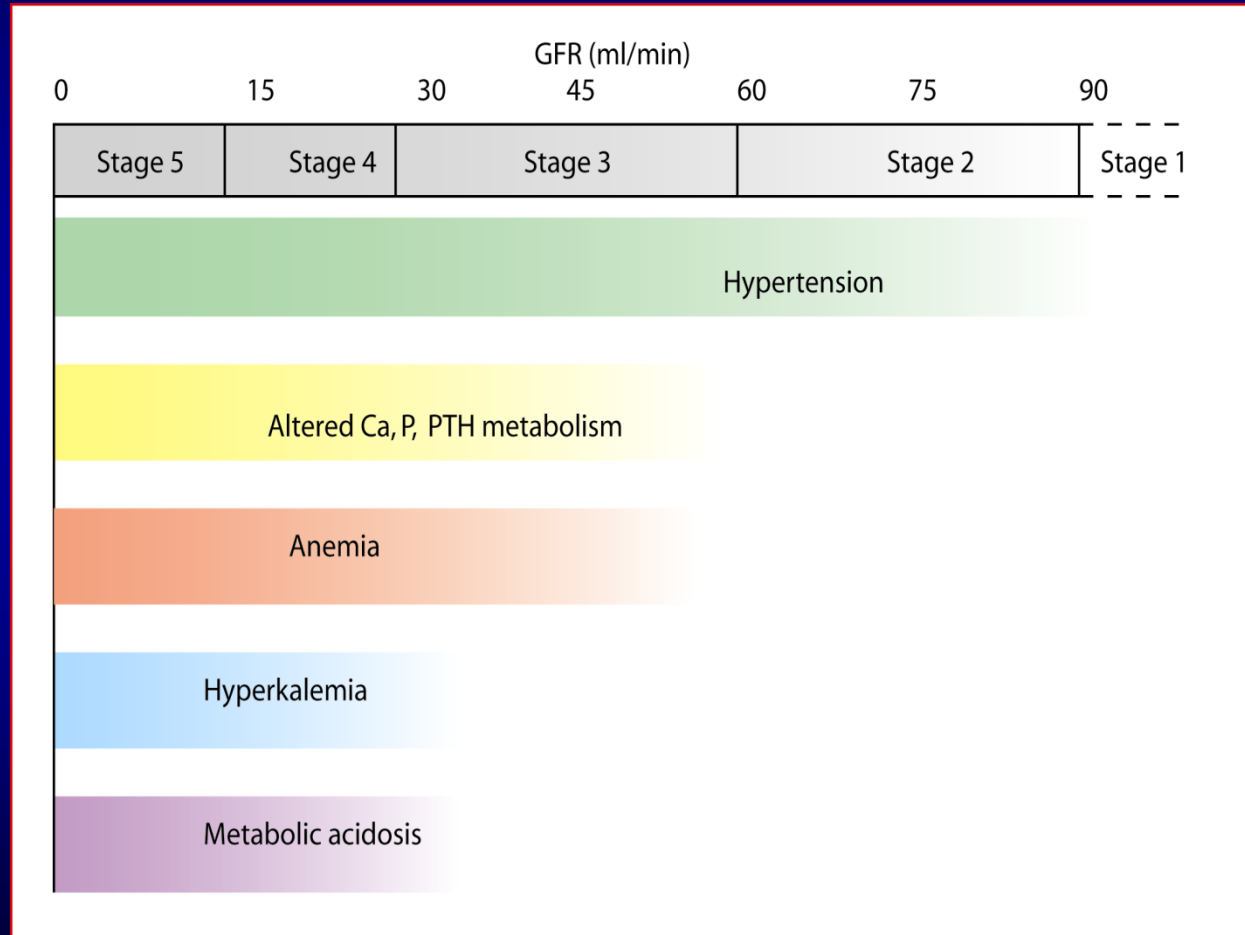
Questions ?

Thank you

Dr. Prakash Prabhu
ppp0809@hotmail.com

Complications of CKD

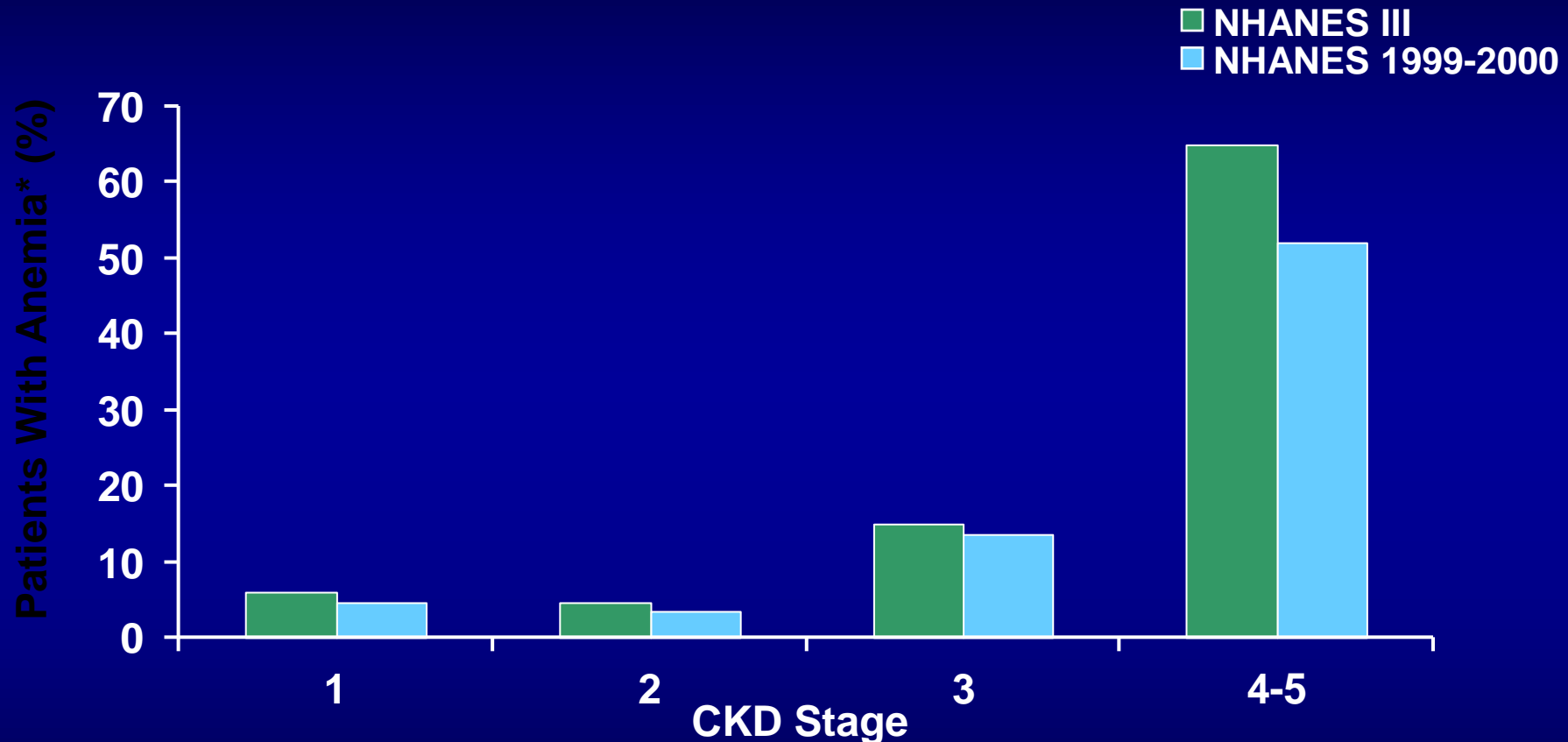
Timing of Complications of CKD



Management of CKD

Anemia

Anemia Prevalence by CKD Stage



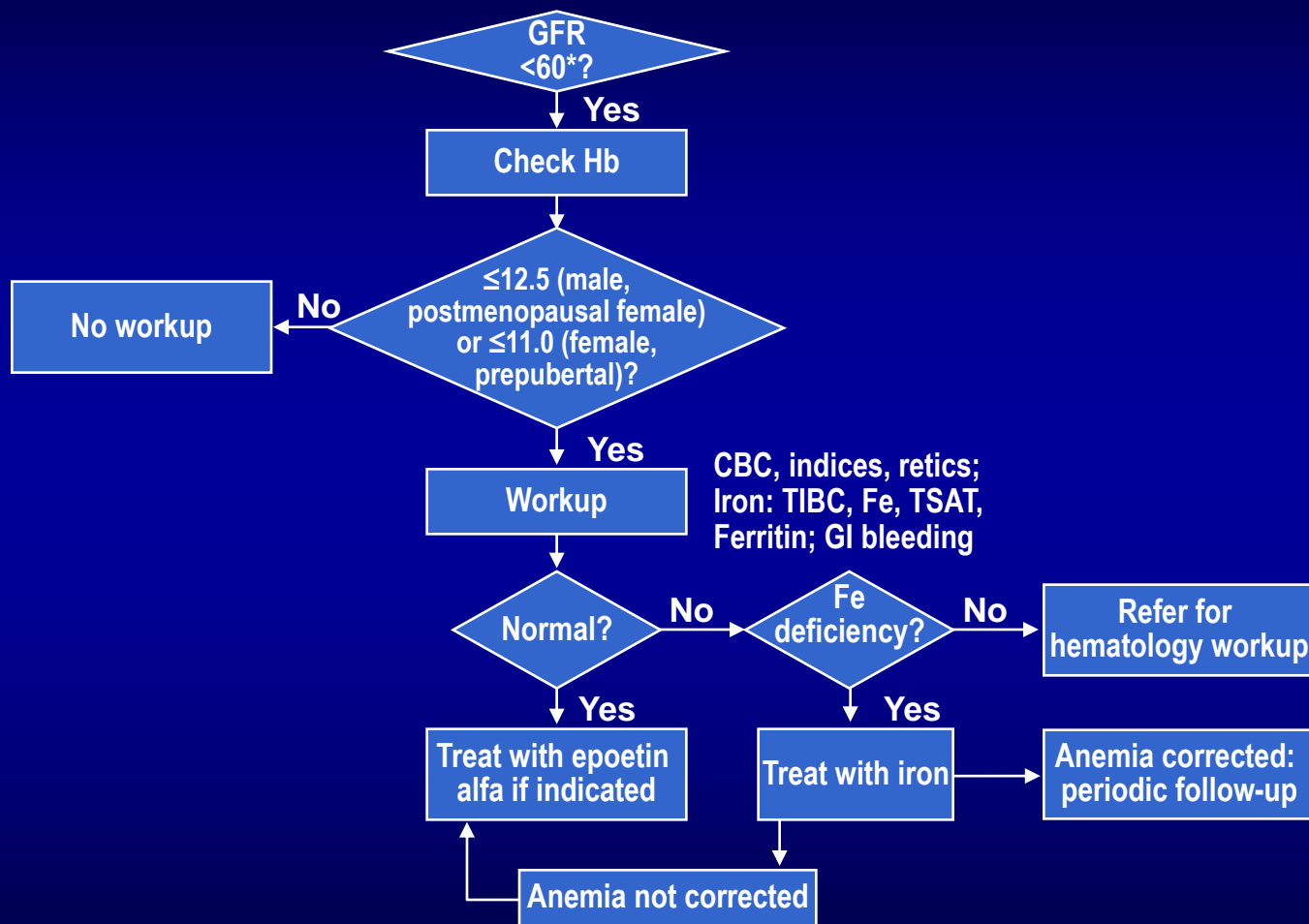
*NHANES participants aged ≥ 20 y with anemia as defined by WHO criteria: hemoglobin (Hgb) < 12 g/dL for women, and Hgb < 13 g/dL for men.

USRDS 2004 Annual Data Report. The data reported here have been supplied by the USRDS. The interpretation and reporting of these data are the responsibility of the author(s) and in no way should be seen as an official policy or interpretation of the U.S. government. Available at: www.usrds.org. Accessed 3/28/05.

Consequences of Anemia in CKD

- Reduced oxygen delivery to tissues
- Decrease in hemoglobin (Hgb) compensated by increased cardiac output
- Progressive cardiac damage and progressive renal damage¹
- Increased mortality risk²
- Reduced quality of life (QOL)³
 - Fatigue
 - Diminished exercise capacity
 - Reduced cognitive function
- Left ventricular hypertrophy (LVH)⁴

Anemia Assessment Flowchart



CBC = complete blood count; Fe = iron; GFR = glomerular filtration rate; GI = gastrointestinal; TIBC = total iron-binding capacity; TSAT = transferrin saturation.

*mL/min/1.73 m².

Adapted from NKF. *Am J Kidney Dis*. 2002;39(2 suppl 1):S1-S266.

Early Treatment of Anemia

- Nutritional therapy
 - Fe (daily)
 - Adults: ≥ 200 mg elemental Fe
 - Children: 2 to 3 mg/kg
 - Folic acid
 - Vitamin B12
- Erythropoietin therapy improves
 - Functional status
 - Quality of life

Target Ranges	
Hgb	11-12 g/dL
Fe	>20% transferrin saturation >100 ng/mL serum ferritin

FE = iron.

NKF. *Am J Kidney Dis.* 2001;37(1 suppl 1):S182-S238; Eknoyan. *Nephrol Dial Transplant.* 2001;16(suppl 5):45-49; Provenzano et al. *Clin Nephrol.* 2004;61:392-405.

When and How to Initiate Erythropoietic Therapy in CKD

A Checklist for Starting therapy

- **Necessary Laboratory data**
 - ☐ Recent serum Creatinine and estimated GFR < 40 ml/min
 - ☐ Hemoglobin < 10 g/dl or Hematocrit < 30% (many providers permit treatment when the Hgb < 11 g/dl or Hematocrit < 33%)
- **Other required data for billing**
 - ☐ Patient age and weight
 - ☐ Product (Epoetin or Darbepoetin), dose, and frequency
 - ☐ Insurance assessed for coverage method
 - ☐ Medicare requires in office administration with MD supervision
 - ☐ Some private insurers require pre-authorization

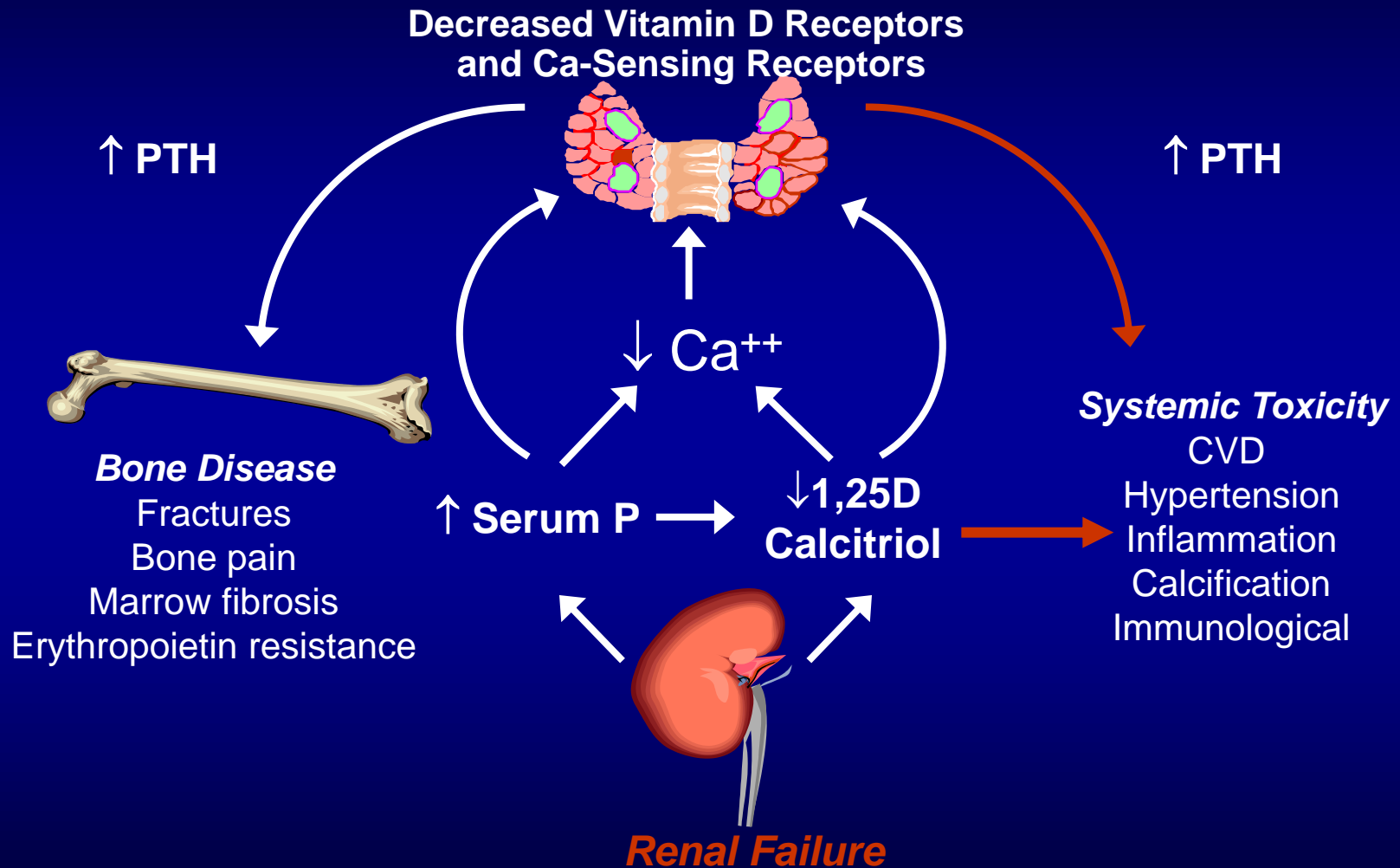
Initial Epoetin and Darbepoetin Dosing

- **Epoetin (Procrit): 20,000u multidose vial**
 - **Starting dose ~ 10,000 u SC weekly or 100 units/Kg weekly**
- **Darbepoetin (Aranesp): Vials and prefilled syringes**
 - **Starting dose: 60 mcg vial q 2 weeks; or 40 mcg if < 50 Kg**
- **Severe anemia can be corrected faster by starting with a higher dose or more frequent dosing, but the increase in Hgb should not exceed 1 g per 2 wks, to avoid hypertension and risk of seizures**

Management of CKD

Calcium, Phosphorus &
PTH

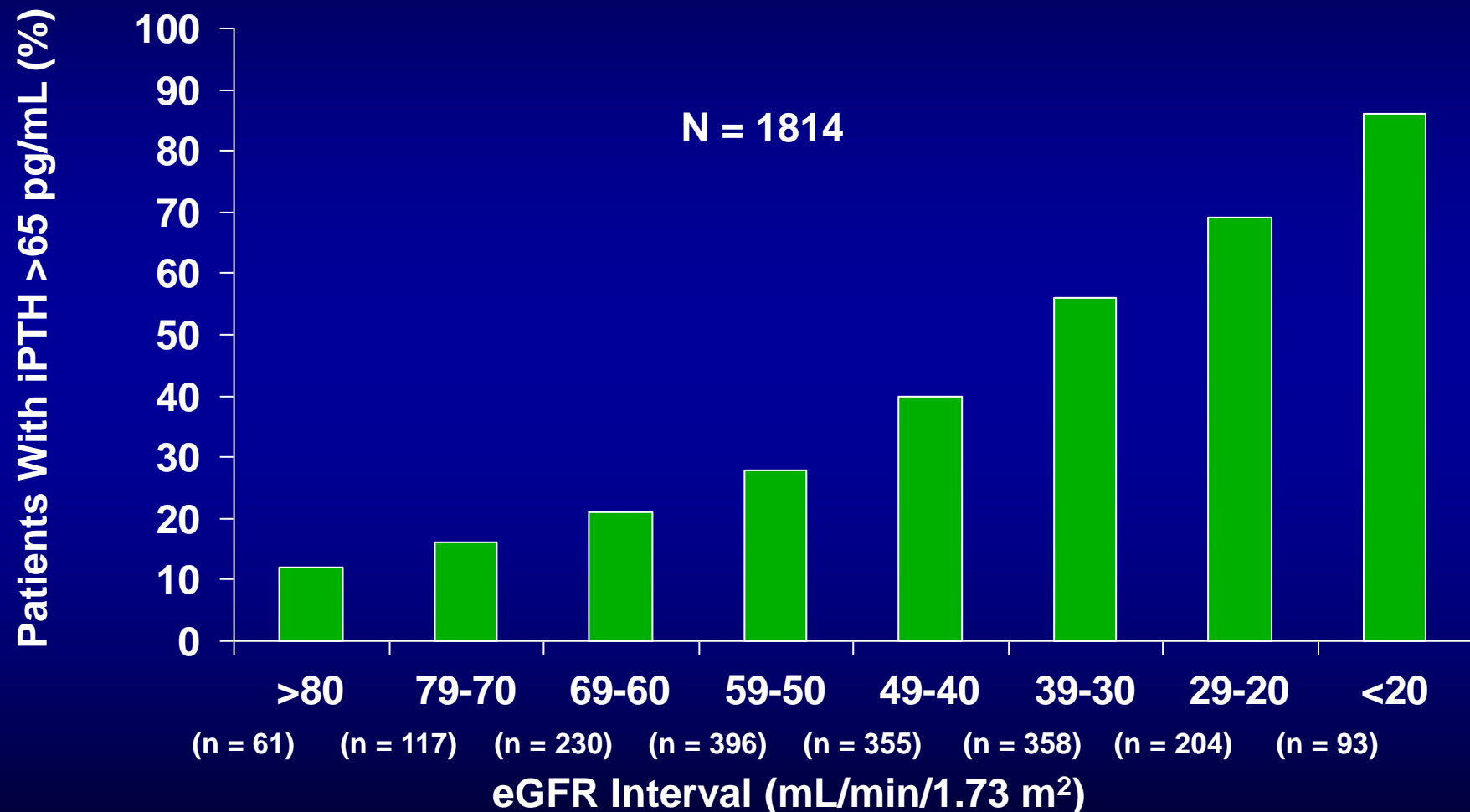
Feedback Loops in SHPT



Ca = calcium; CVD = cardiovascular disease; P = phosphorus; SHPT = secondary hyperparathyroidism.

Courtesy of Kevin Martin, MB, BCh.

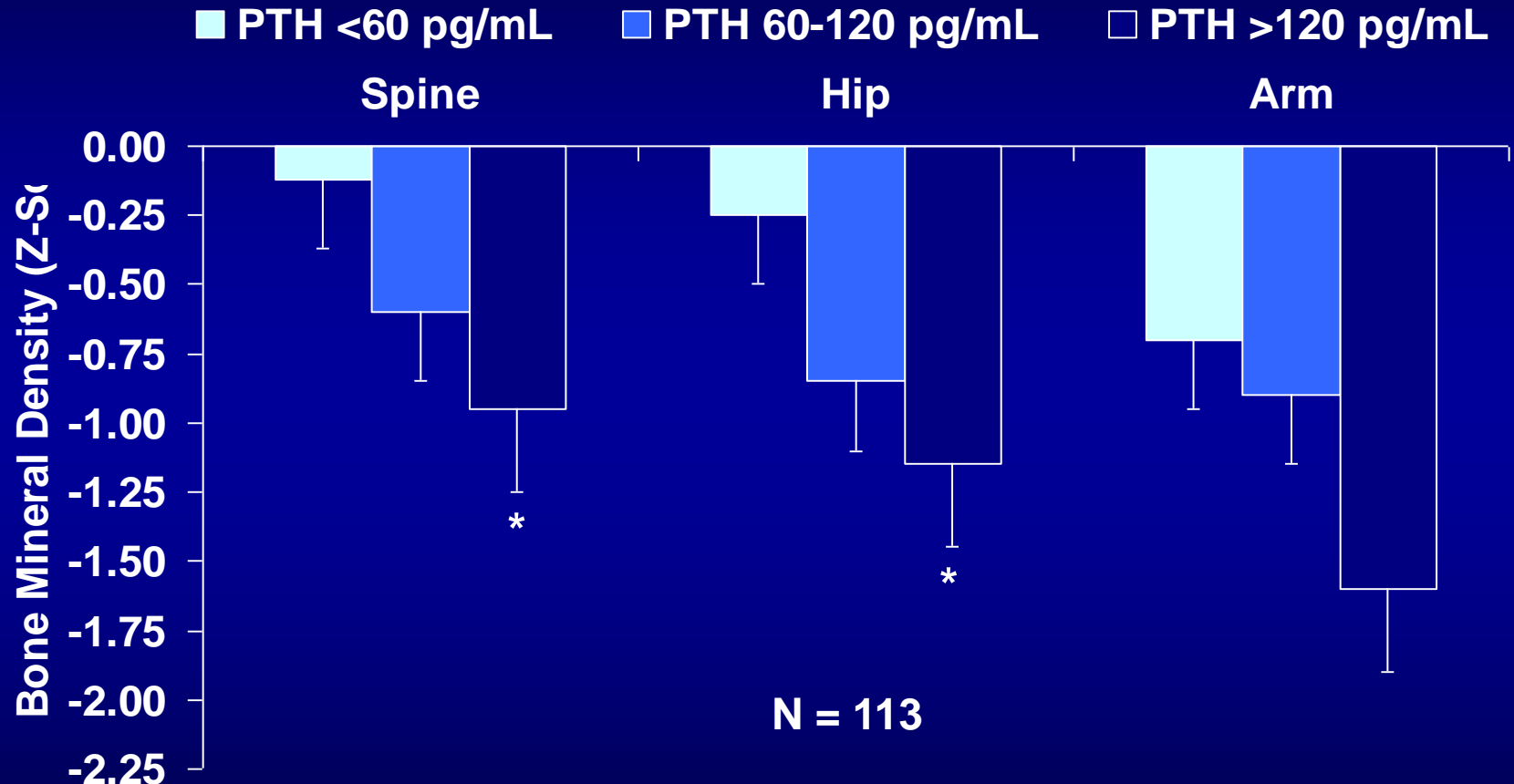
Prevalence of Elevated iPTH by eGFR Intervals



iPTH = intact parathyroid hormone.

Bakris et al. Poster presented at: American Society of Nephrology Renal Week 2005; November 8-13, 2005; Philadelphia, PA. Abstract F-PO732.

Bone Loss Correlates With Severity of SHPT in CKD

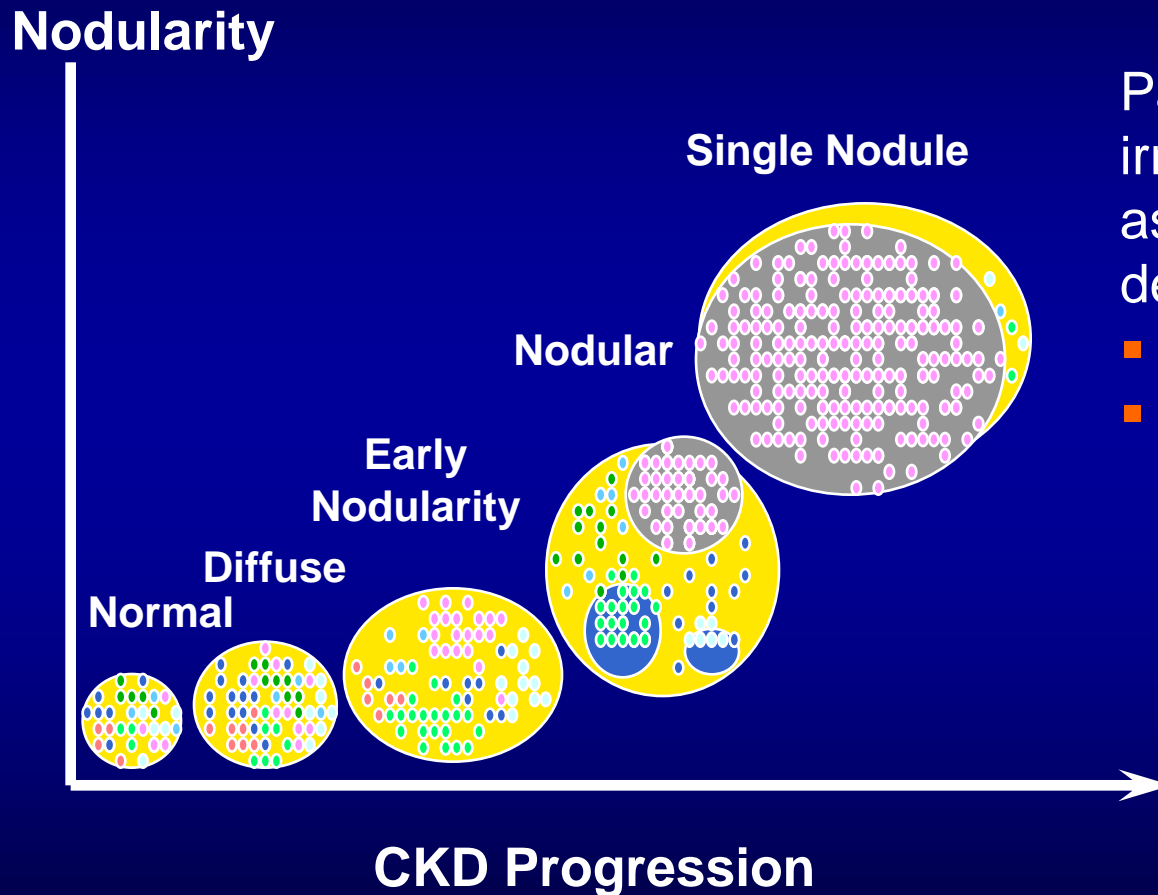


* $P < 0.05$ compared with patients with PTH in the normal range.

Z-Score = comparison to the mean value for women at a similar risk, including age, weight and ethnicity.

Rix et al. *Kidney Int.* 1999;56:1084-1093.

The Progression of SHPT in CKD: Parathyroid Growth Becomes Irreversible



Parathyroid nodularity is irreversible and associated with decreased levels of

- Vitamin D receptor
- Ca-sensing receptor

Early Assessment for Treatable Consequences of Altered Mineral Metabolism in CKD

Consequences in CKD ¹	eGFR (mL/min/1.73 m ²)	CKD Stage
1,25 Vitamin D Deficiency	<65	2-3
Hyperparathyroidism	<65	2-3
Hyperphosphatemia	<40	3-4
Hypocalcemia	<30	4-5

Assessment²

- Stage 3: Ca, P, PTH every 12 mo
- Stage 4: Ca, P, PTH every 3 mo
- If PTH > target range, measure 25(OH)D at first encounter and repeat annually if normal

CKD

```
graph TD; CKD[CKD] --> PR[Phosphate retention]; CKD --> LCL[Low levels of calcitriol]; PR --> H[Hypocalcemia]; LCL --> H; PR --> HP[Hyperparathyroidism]; LCL --> HP; H --> HP;
```

Phosphate retention

Low levels of calcitriol

1. Diet restrict PO_4
2. Start binders

3. Check precursor 25OH-D
Rx: Ergocalciferol
4. Start Active Vit D

Hypocalcemia

Hyperparathyroidism

Monitor Calcium and Phosphorus, PTH at least quarterly

HIGH PHOSPHORUS FOODS

DAIRY

Cheese, all types
Cream
Cream Pies or Desserts
Custard
Frozen Custard
Ice Cream
Ice Milk
Milk, all kinds
Pudding
Yogurt

MISCELLANEOUS

Chocolate
Nuts

BEVERAGES

Beer
Colas
Wyler's Lemonade Mix

PROTEIN FOODS

Braunschweiger
Eggs
Liver
Peanut Butter
Salmon
Sardines
Tuna

VEGETABLES

Bakes Beans and Pork-n-Beans
Beans (Kidney, Lima, Red)
Dried Beans (White, Navy, Pinto)
Dried Peas (Black-eyed, Split Pea)
Lentils
Mixed Vegetables
Soybeans and Soy Foods

BREADS AND CEREAL

Barley
Bran
Cornbread
Waffles (From Mix)
Whole Grain Breads

Phosphate binders

- Calcium containing
 - Calcium acetate (Phos-Lo)
 - Calcium carbonate (Tums, Tums EX)
- Non-calcium containing
 - Sevelamer hydrochloride (Renagel)
 - Lanthanum carbonate (Fosrenol)
- Schedules
 - With meals - P binder + Ca supplement
 - At bedtime - Ca supplement

CKD

```
graph TD; CKD[CKD] --> PR[Phosphate retention]; CKD --> LCL[Low levels of calcitriol]; PR --> H[Hypocalcemia]; LCL --> H; PR --> HP[Hyperparathyroidism]; LCL --> HP; H --> HP;
```

Phosphate retention

Low levels of calcitriol

Hypocalcemia

Hyperparathyroidism

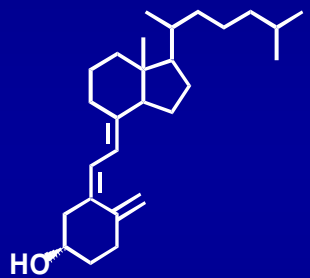
1. Diet restrict PO_4
2. Start binders

3. Check precursor 25OH-D
Rx: Ergocalciferol
4. Start Active Vit D
(calcitriol, doxercalciferol & paracalcitol)

Monitor Calcium and Phosphorus, PTH at least quarterly

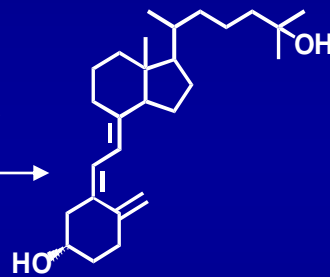
Vitamin D Metabolism

Active Vitamin D



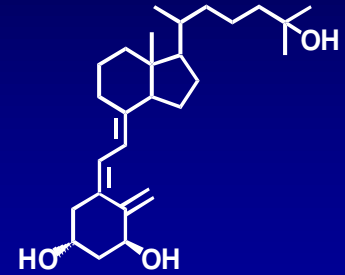
vitamin D₃

Liver



25(OH)D₃

Kidney



1 α ,25(OH)₂D₃



24,25(OH)₂D₃

Inactive D

-----Inactive Vitamin D-----

Vitamin D in Chronic Kidney Disease: Stages 3 and 4

Measure serum 25-hydroxyvitamin D in patients with elevated PTH.

If 25-OH-D is normal, repeat annually

Level	Treatment with Ergocalciferol
<5 ng/mL	50,000 U/wk x 12, then q month x 6
5-15 ng/mL	50,000 U/wk x 4, then q month x 6
16-30 ng/mL	50,000 U/month x 6

Recommended Goals for Hormone and Mineral Metabolism

Parameter	Recommendation
iPTH (pg/mL)	Stage 3: 35-70; stage 4: 70-110
Serum 25(OH) vitamin D (ng/mL)	>30
P (mg/dL)	2.7-4.6
Ca (mg/dL)	Normal parameters for the lab
Ca × P product (mg ² /dL ²)	<55

SUMMARY

- CKD is very common
- CKD populations are easily identifiable and accessible
- Guidelines for prevention & management of CKD available
- CKD care can be improved
- CKD patients are at high risk for cardiovascular disease
- Development of ESRD can be delayed

Questions ?

Thank you

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